The Effect of the "Yes, I Can! Sleep Education Programme" on Children's Sleep, Working Memory and Emotion Recognition – A Pilot Study

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Abstract

Objective: In this study, the researcher investigated the effects of the *Yes I Can! Sleep Education Programme* (YIC Programme) (Liberty, 2018) in school-age children's sleep, working memory and emotion recognition in a post-disaster community. ***Methods:*** The study adopted a single-subject design. The YIC Programme was implemented in School A as a part of the regular school curriculum for a term. Ten children from School A completed seven-night sleep diaries, the Sleep Self Report (SSR) Questionnaire, and two Cambridge Neuropsychological Test Automated Battery (CANTAB) cognitive tasks, including the Spatial Working Memory (SWM) task and the Facial Emotion Recognition Task (ERT) during three time-periods. ***Results:*** Seven children fully engaged in the YIC programme, and the other three partially engaged. The impacts of the programme appeared to be individual-specific, and some of these positive effects were likely to be relevant to the exposure of treatment. More children in the full engagement group showed more stabilized time in bed, reported fewer overall sleep problems, demonstrated better performances on the working memory task and the emotion recognition task. ***Conclusions:*** The findings suggest a promising outlook for sleep education programmes in improving school-age children's sleep and areas of cognitive functions. Future researchers conducting studies of sleep education programmes should consider exploring the following areas: (1) The impact of sleep education programmes on improving specific sleep behaviours; (2) The associations between bedtimes, wake-up times, morning feelings and daytime feelings; (3) A comparison of children's sleep durations using recommended time in bed for their age-group; and (4) Including measures of cognitive performance.

Chapter One: Introduction

Age-appropriate hours of sleep play an essential role in all areas of children's development, including physical, emotional and cognitive (Bagley & El-sheikh, 2013). The New Zealand Ministry of Health recommend nine to eleven hours of sleep per night for school-aged children (Ministry of Health NZ, n.d.). A recent New Zealand study by Muller, Signal, Elder, and Gander (2017) conducted with 52 children between six to eight years reported that, on average, children slept for ten hours during school nights. Nevertheless, approximately 37% of the study children also reported having sleep problems (Muller et al., 2017).

Sleep problems referred to disturbances in sleep that were not considered to be at a clinical level, that is they were not a sleep disorder (Bagley & El-sheikh, 2013). Sleep problems might include insufficient time in bed, inadequate sleep quality, inconsistent bedtime routine, having trouble falling asleep, night-waking, being unable to return to sleep, having difficulty waking in the morning, experiencing nightmares, snoring, and feeling tired during the day (Bagley & El-sheikh, 2013).

Sleep problems are associated with several different factors. These included bedroom sharing, consumption of caffeinated drinks, the presence of TV and other electronic devices, as well as long screening time at night (Muller et al., 2017). Cultural perspectives could impact sleep problems, as these might affect sleeping arrangements (e.g., co-sleeping), beliefs about sleep (e.g., children who sleep less are more intelligent) and bedtime routines (Super & Harkness, 2013). Social and demographic factors have been linked to sleep problems. These included living in a disadvantaged neighbourhood, being in an ethnic minority group, experiencing family conflict, and being exposed to natural disasters (Hale, Parente, & Phillips, 2013; Shaw, Espinel, & Shultz, 2012).

Sleep Problems and Natural Disasters

Compared with adults, children were more likely to be disposed to long-term negative consequences resulting from natural disasters, one of which was showing sleep problems (Shaw et al., 2012). Studies have reported that children and adolescents exhibited sleep problems in the context of different forms of natural disasters. These forms of natural disasters include tsunamis (Iwadare et al., 2014; Vijayakumar, Kannan, & Daniel, 2006), cyclones (Kar & Bastia, 2006), hurricanes (Brown, Mellman, Alfano, & Weems, 2011) and earthquakes (Chen, Lin, Tseng, & Wu, 2002; Chen & Wu, 2006; Yorbik, Akbiyik, Kirmizigul, & Sohmen, 2004). Due to the unpredictable nature of earthquakes, studies conducted in post-earthquake communities reported a higher prevalence of sleep problems in children and adolescents (Chen et al., 2002; Chen & Wu, 2006; Usami et al., 2013; Yorbik et al., 2004; Zhou, Wu, An, & Fu, 2014).

The association between earthquakes and sleep problems was specifically relevant to the study of sleep problems in Christchurch, New Zealand, because of the continuous earthquake activity in recent history. On September 4th, 2010, the Canterbury Plains of New Zealand, was struck by a magnitude 7.1 earthquake, leading to significant damage to the region and approximately 100 people were injured (New Zealand History, n.d.). Of the numerous aftershocks which since hit the region, on February 22nd, 2011, at 12:51 pm, Christchurch was struck by a magnitude 6.3 earthquake, taking 185 lives, causing thousands of injuries and damaging numerous infrastructure and buildings of Christchurch (New Zealand History, n.d.). Residents in Christchurch and the Canterbury regions have since experienced thousands of aftershocks in a continuous period that lasted more than seventeen months (Christophersen, Rhoades, Hainzl, Smith, & Gerstenberger, 2013). More recently, at midnight 14th November

2016, a magnitude 7.8 earthquake struck Kaikōura, causing a large number of landslides and significant devastation to the infrastructure (GeoNet, n.d.).

Liberty and Colleagues (Liberty, Tarren-Sweeney, Macfarlane, Basu, & Reid, 2016) recruited 212 children who were under the age of four when the 2010 earthquake struck. Problem behaviours, post-traumatic symptoms, and sleep problems were measured in this group of children when they first entered primary school at the age of five (post-earthquake group). Similar measures took place in a group of children when they first entered primary school in 2006 (pre-earthquake group). The study found that post-earthquake children had significantly more behaviour problems ($M = 6.11$, $SD = 7.65$) compared to the pre-earthquake children ($M = 3.78$, $SD = 5.39$). More children in the post-earthquake group (20.7%) showed post-traumatic symptoms compared to the pre-earthquake group (8.8%). In particular, 73.1% of post-earthquake children reported having one or more sleep problems. These included: trouble going to sleep, nightmares, fear of sleeping alone, night-waking, and bed-wetting/ bed-soiling (Liberty et al., 2016). Similar sleep problems were reported by adolescents who survived the Wenchuan earthquake. They reported insufficient sleep duration, poor sleep quality, difficulty going to sleep, night-waking, and trouble with daytime functioning. (Geng, Fan, Mo, Simandl, & Liu (2013).

Some studies have examined factors that were likely to contribute to children's sleep problems following exposure to natural disasters (Charuvastra & Cloitre, 2009). For example, female gender predicts children's sleep onset and maintenance problems (Wittmann, Zehnder, Jenni, & Landolt, 2012). Exposure to additional stressful life events after experiencing a natural disaster and higher perceived post-disaster stress levels were associated with poor sleep quality and insufficient sleep duration (Llabre & Hadi, 2009). Moreover, sleep problems and symptoms

of Posttraumatic Stress Disorder often co-occurred, and the association between sleep problems and Posttraumatic Stress Disorder appeared to be bi-directional (Cox, Tuck, & Olatunji, 2017).

Sleep Problems and Cognition

The function of sleep in regard to learning and cognition has been extensively studied. Among adults, the association between sleep and memory consolidation is well supported by empirical evidence (Curcio, Ferrara, & Gennaro, 2006; Walker, Liston, Hobson, & Stickgold, 2002). Among children and adolescents, lack of sleep and sleep problems were often investigated in relationship to school performance and cognitive performance. Literature has shown that late bedtimes, early awakenings, poor sleep quality and frequent sleep fragmentation affected school performance, learning capacity, and neurobehavioral functioning among school-aged children (Sadeh, Gruber, & Raviv, 2002; Vriend et al., 2013). Moreover, behavioural problems and dysregulated emotions were often present in healthy children who report experiencing sleep problems (Curcio et al., 2006; Sadeh, 2007), and these associations have been reported as bidirectional (Quach, Nguyen, Williams, & Sciberras, 2018). More recently, one study found a causal relationship between inadequate sleep duration and impaired daytime functioning, including poor attention, disruptive behaviours and daytime sleepiness among adolescents with ADHD (Becker et al., 2019).

Sleep duration, sleep quality and sleepiness were among the most studied sleep variables with relation to school performance and cognitive performance (Beebe, 2011; Bub, Buckhalt, & El-Sheikh, 2011; Dewald, Meijer, Oort, Kerkhof, & Bogels, 2010). Dewald and colleagues (Dewald et al., 2010) analysed 26 studies that examined the association between school performance and sleep duration, sleep quality, and sleepiness, respectively. Participants in these 26 studies were between the ages of eight to seventeen. Dewald and colleagues (Dewald et al.,

2010) found that longer sleep duration was related to better school performance (r = 0.07), and sleep quality was positively associated with school performance (r = 0.1). On the other hand, sleepiness was negatively associated with school performance (r = - 0.13). Other meta-analytic studies demonstrated comparable results. Astill and colleagues (Astill, Van der Heijden, Van Ijzendoorn, & Van Someren, 2012) performed a meta-analytic study to explore the relationship between sleep, cognition, and behavioural problems among healthy school-aged children. The authors evaluated 86 studies that comprised 35,936 children between the ages of five to twelve. They found that sleep duration had a positively impact on overall cognition (r = 0.08), executive functioning (r = 0.07), and school performance (r = 0.09). Short and colleagues' (Short et al., 2018) meta-analytic study reported similar results on the positive association between sleep duration and overall cognition (r = 0.06).

Sleep problems and working memory. Research has also looked more specifically at cognitive performance aspects, including executive function (Turnbull, Reid, & Morton, 2013). Executive function includes self-regulatory and cognitive functions. Two crucial executive functions impacted by sleep problems include working memory and response inhibition; both have been extensively studied concerning children's learning and behaviour problems (i.e. Bayliss, Jarrold, Gunn, & Baddeley, 2003; Kahle, Utendale, Widaman, & Hastings, 2018).

Working memory was one component of executive function and has been described as a system to temporarily store and recall information while performing cognitive tasks (Baddeley, 1992). Research has shown that children's working memory was vital in reading ability and classroom behaviours (Bayliss et al., 2003; Daneman & Carpenter, 1980). Working memory was also related to sleep, and, in particular, the previous night's sleep could affect the cognitive performance of children, with poor sleep quality or reduced sleep duration associated with poorer

working memory (Kopasz et al., 2010; Könen, Dirk, & Schmiedek, 2015). Insufficient sleep efficiency and prolonged sleep latency were associated with poorer accuracy on working memory tasks (Steenari et al., 2003). Inadequate sleep quality had a negative impact on working memory difficulties in children aged six to eleven years with neurological conditions (McCann, Bayliss, Pestell, Hill, & Bucks, 2018).

Sleep problems and emotion recognition. Response inhibition has also been labelled as inhibitory control and involves the ability to modulate behavioural and cognitive responses in challenge, change and conflict situations (Morasch & Bell, 2011). For example, in a classroom context, children must be able to attend to the teacher even in the presence of distracting events (attentional control has also been identified as a separate executive function). Learning new skills was an example of a challenge condition in which children must direct their attention and recognise and identify the important stimuli. The lack of inhibitory control has been associated with the development of conduct problems, as well as mental health conditions, such as PTSD, in which fear, or hyper-arousal, affected children's response inhibition (Utendale & Hastings, 2011; Shaw et al., 2012). Response inhibition was associated with sleep problems in children (Kahle et al., 2018). Thus, response inhibition was related to PTSD and sleep problems, both of which were related to children who have experienced earthquakes.

Recognizing emotion from facial expressions was a crucial element in children's daily interpersonal interactions and was closely related to executive function (i.e. inhibitory control) (Tottenham, Hare, & Casey, 2011). Furthermore, emotion recognition in children was associated with performance on language and math tasks (Agnoli et al., 2012). For example, if children interpreted an adult's face as threatening or angry, their executive functions would respond as if to a dangerous situation. However, if the adult's face was neutral, and the child inaccurately

interpreted their expression, their executive function and self-regulation would be negatively affected. Adolescents who were at high risk of psychosis often misidentified neutral facial expressions as angry faces (Van Rijn et al., 2011); meanwhile, children with diagnoses of psychiatric disorders typically also showed difficulties in facial emotion recognition (Collin, Bindra, Raju, Gillberg, & Minnis, 2013). Moreover, poor emotion recognition was found to be associated with childhood depression and anxiety (Demenescu, Kortekaas, den Boer, & Aleman, 2010). A review conducted by Pechtel and Pizzagalli (2011) identified that early life stress, such as might be associated with natural disasters, affected the development of the executive functions, including inhibitory control involving facial emotion recognition.

Many studies have investigated the association between sleep problems and emotion recognition, focusing on sleep deprivation and emotional facial recognition (for a review, see Beattie, 2018). Studies involving adults reported mixed results. For example, Killgore and colleagues (Killgore, Balkin, Yarnell, & Capaldi II, 2017) found that for healthy adults, the accuracy of successfully identifying happy faces and sad faces significantly decreased following only one-night of sleep deprivation. This result was in line with the findings previously published in Van Der Helm and colleagues' study (Van Der Helm, Gujar, & Walker, 2010), in which they reported a deteriorated performance in recognizing happy and angry facial expressions that were subtler and more towards neutral faces following one night's sleep deprivation among healthy adults. This was not the case for recognizing sad faces, which was intact after one night's sleep deprivation. On the other hand, Holding et al (2017) suggested emotion recognition was independent of sleep duration, sleep quality and insufficient sleep. Studies involving children were scarce. In one large study that involved 94 ten-year-old healthy children, researchers reported that children with high frequent night-waking and decreased sleep

efficiency had poor performance in facial emotion recognition tasks (Soffer-Dudek, Sadeh, Dahl, & Rosenbalt-Stein, 2011).

Summary

Although causation might not be definitively identified, sleep problems in children are associated with children's sleep arrangements and bedtime routine, electronic devices usage, caffeine intake, social-economical disadvantages and experiences of natural disasters, including earthquakes. Sleep problems posed several serious problems for children, including compromised learning capacity, deteriorated school performance, behavioural problems, dysregulated emotions, and impaired executive functions such as working memory and emotion recognition. The importance of sleep and sleep problems for children has led to the development of interventions designed to improve children's sleep. These are reviewed in the next Chapter.

Chapter Two: Research on Interventions for Children's Sleep

There has been a growing body of literature on sleep education programmes. These programmes were mostly designed to be delivered by teachers as a part of regular curriculums at school, and they aim to improve participants' sleep knowledge and sleep behaviours (Gruber, 2017). Sleep education programmes have been reported as effective in improving children's sleep knowledge; however, their impact on sleep parameters, including sleep behaviours, sleep hygiene, sleep duration, sleep quality, and sleep efficiency, were found inconsistent across studies (Gruber, 2017). For example, Blunden and colleagues (Blunden, Kira, Hull, & Maddison, 2012) reported post-sleep education improvements in sleep duration and sleep knowledge for 98 adolescents from Australia and New Zealand who participated in the study. Rigney and colleagues (Rigney et al., 2015) evaluated the effectiveness of the modified junior version of the same sleep education programme in Rigney and colleagues' study (Rigney et al., 2015) among 296 school-aged children (M_{Age} = 12.2 years, SD = 0.6). The authors found that the sleep education programme positively affected time in bed for children in the intervention group. However, no effect was reported on sleep hygiene or sleep knowledge. Although mixed results were often reported in studies evaluating sleep education programmes, sleep education programmes were considered advantageous in the following aspects, (i) the intervention could be customized to suit participants' developmental needs and their ecological environments (i.e. cultural context) (Gruber, 2017), (ii) sleep education programmes could address a much wider group of participants within a relatively short time frame (Rigney et al., 2015).

Reviews on Sleep Education Programmes for School-aged Children

Blunden and colleagues (Blunden, Chapman, & Rigney, 2012) reviewed the literature on school-based sleep education programmes that targeted healthy children and adolescents. They described each sleep education programme, evaluated the efficacy of each programme in achieving its desired outcomes, and analysed factors that were likely to contribute to the programme's success. Eight studies and four study abstracts published from 1990 to 2011 were selected and reviewed by the authors. Eight of the twelve studies adopted randomised controlled trial designs, using group comparisons between the intervention group and the control group before and after the intervention. The other four studies used pre-post measures to evaluate the effects of the sleep interventions. One study recruited junior school students with a mean age of nine and a half years; the rest of the sleep education programmes were designed for adolescents between fourteen and nineteen. The number of participants in the studies ranged from 22 to 1200. Four studies were conducted in Australia, three in the US, two in Brazil, one in Croatia, one in Italy and one in New Zealand.

The characteristics of sleep education programmes varied (Blunden et al., 2012). Of the twelve studies, five studies examined independent sleep education programmes that were tailor-made. Three studies evaluated the effectiveness of the Australia Centre for Education in Sleep programme (ACES). Two studies did not provide detailed information on the sleep education programme. One study tested the Sleep Treatment and education programme for students (STEP). One study delivered a sleep hygiene programme only.

Most sleep education programmes consisted of a definition of sleep, the human physiology behind the sleep, the optimal hours of sleep, factors that affect sleep and the consequences of sleep problems. An individual sleep education session's duration ranged from 30 minutes to two

hours, with an average session duration of 45 to 50 minutes. The total sessions in each sleep education programme ranged from one session to twelve sessions. The duration of sleep education programmes ranged from one day to seven weeks. All sleep education programmes were implemented during regular school hours. A follow-up period of the programmes ranged from four weeks to twelve weeks post-intervention. Most sleep education programmes were delivered by teachers alone or in coordination with psychologists, study authors, teachers, sleep professionals, and graduate students.

Blunden et al (2012) listed some shared sleep parameters measured as outcome variables in evaluating the effectiveness of the sleep education programmes. These were: sleep knowledge, sleep patterns, sleep habits, sleep quality, daytime sleepiness, sleep hygiene practices, and sleep duration. These variables were measured by self-report except for one study that incorporated both self-report and objective measures. Besides this, four out of the twelve studies included outcome variables other than sleep parameters. These were: mood, motivation, sedentary behaviour, self-efficacy, and physical activity. All were measured using self-report.

The authors (Blunden et al., 2012) stated that based on the studies they reviewed, sleep education programmes were useful in improving children's sleep knowledge but less so in changing sleep-related behaviour and other sleep-related variables such as physical activity and mood. Among the twelve studies reviewed, significant improvement in sleep knowledge was found in six studies; two studies reported improved sleep hygiene practice, and one study reported improvement in daytime sleepiness. A significant increase in sleep duration was reported in one study. No changes in sleep quality nor sleep habits were detected. Most sleep education programmes had little effect on improving sleep-related variables, except for one study that reported improvement in children's motivation in regulating wake-up time.

Blunden and colleagues (Blunden et al., 2012) argued that their meta-analysis provided insights into evaluating the effects of sleep education programmes available in the literature. Firstly, they suggested that although improved sleep knowledge was reported in most studies, each sleep education programme comprised different components of sleep knowledge. Secondly, they stated that study authors used different sleep parameters when measuring a sleep education programme's effectiveness. As a result, it was less evident as to which particular sleep parameter could benefit the most from implementing sleep education programmes. They further suggested that future development of sleep education programmes should consider accommodating the necessary cultural and ecological environment that unique to the targeted population.

Subsequently, Busch and colleagues (Busch, Altenburg, Harmsen, & Chinapaw, 2017) performed a literature review and meta-analysis on interventions that aimed to improve sleep duration and sleep routine for children between four to twelve years. The authors included interventions that targeted children, parents, schools and policymakers as long as the primary goal of the intervention was for improving children's sleep duration and sleep routine. The authors calculated the effect sizes for each study to reflect the efficacy of sleep intervention on the outcome variables. Intervention components in each study were coded based on behavioural change techniques in the "Behavioural Change Taxonomy version 1" (Michie et al, as cited in Busch et al., 2017, pp. 54). Two study authors assessed each study quality using the quality Assessment Tool for Quantitative Studies (Busch et al., 2017).

Eleven studies published between 1997 and 2016 were examined (Busch et al., 2017). Seven of the eleven studies adopted randomised controlled trial designs, of which, two used clustered randomised controlled trial designs. Of the remaining four studies, two studies adopted

controlled trial designs, one was a pre-post measure design, one used an interrupted time series experiment/cross-over design. Among the eleven studies, six studies were designed for children between the ages of four to six years; three were intended for children between six to eleven, two included children from twelve to thirteen. The number of participants in the studies ranged from 93 to 8543. Six studies were conducted in the US, one in Australia, one in France, one in China, one in Israel, and one in Europe (six countries).

Of the eleven interventions, four interventions targeted children directly, and others were designed for parents or school policymakers. Five studies were conducted in school; two studies were set at home, two studies included home and school setting, one study included school, home and community setting, one study included home, school and parental workplace settings.

Sleep duration and bedtimes were measured in all studies. Other outcome variables comprised physical activity (four out of eleven studies), duration of TV watching (three out of eleven studies) and diet (four out of eleven studies) (Busch et al., 2017).

Some sleep interventions showed significant effects in changing sleep parameters (Busch et al., 2017). Five of the eleven sleep interventions significantly improved sleep duration (improvement between eight to 45 minutes). The improvements were maintained in three out of the five studies over six months to two years. One study reported a significant effect in shortening sleep onset latency; one study reported improved daytime sleepiness. No significant effect was found for sleep hygiene or bedtime.

Busch and colleagues (Busch et al., 2017) analysed the intervention components in each sleep intervention, and they evaluated the overall study quality for each study. An antecedent technique was found in five interventions. Natural Consequences and Comparison of Outcomes techniques were used in four interventions. A Comparison of Outcomes strategy alone was used

in four interventions. The Social Support strategy was applied to four interventions. Feedback and Monitoring techniques were found in three interventions. Goals and Planning – coach and parents' techniques were adopted in three interventions. Comparison of Behaviour strategy was used in three interventions. The Reattribution strategy was used in two interventions. Repetition and Substitution techniques were found in one intervention. Among the eleven studies reviewed, two were rated by Busch and colleagues (Busch et al., 2017) as strong in methodological quality, three as moderate, and six as weak. In the two studies in which methodological quality was rated as strong, both interventions were designed for parents to manage young children's sleep.

The authors (Busch et al., 2017) stated that their study generated mixed results in evaluating the effectiveness of sleep interventions due to the small number of studies suitable for their review. However, the authors believed that their study revealed factors that were more likely to make future sleep interventions successful. They found that sleep interventions that were created using multiple behavioural change strategies and extended to include the home setting in addition to the school setting were most likely to be successful. They stated that interventions that targeted sleep and other health behaviours at the same time appeared to be most effective because of the "transfer of learning" (Busch et al., 2017, pp. 55) experiences created in implementing sleep interventions. In other words, children were more likely to change other health-related behaviours at the same time they change sleep behaviours. Furthermore, Busch et al. (2017) believed that when children were invited to be actively involved in the decision-making process during the implementation of sleep interventions, their cognitive beliefs in changing specific sleep-related behaviour would be strengthened, as demonstrated in the studies of their analysis.

Similar to Blunden and colleagues' (2012) findings, Busch and colleagues (Busch et al., 2017) indicated that evidence-based sleep interventions for healthy school children were scarce. No conclusion can be reached from the mixed results in the current sleep intervention studies due to a small number of studies in the literature and a small number of participants in each study. They suggested that future research examine the target children's bioecological factors to design suitable sleep interventions for these children. Universal preventative interventions designed to help children reach regular bedtimes and sufficient sleep duration were desired, according to Busch et al. (2017).

Summary of the meta-analyses. The two meta-analyses summarised and evaluated sleep interventions for children and adolescents available in the current literature. Blunden and colleagues (2012) focused on school-based sleep education programmes, whereas Busch et al. (2017) broadened the intervention settings to include home, community and parental workplace. Both meta-analyses summarised participants, study design, characteristics of the interventions and overall results of the studies. Based on the two meta-analyses, the literature showed a lack of interventions designed for school-aged children. Most of the sleep education programmes Blunden and colleagues (2012) reviewed were designed for adolescents (eleven out of twelve). In contrast, the interventions Busch and colleagues (2017) examined mainly were designed for much younger children and their families (five out of eleven interventions were provided to children under six years old). School-aged children have different sleep needs and sleep patterns than children of younger ages. The factors that influence sleep at different developmental stages also vary (Iglowstein, Jenni, Molinari, & Largo, 2003). Furthermore, sleep education programmes are often administered in school, where a broad range of children, including those

with neurological conditions, attend. As a result, the authors of these two reviews/meta-analyses suggested future studies to include a more substantial sample of primary school-aged children.

Both meta-analyses summarized intervention components that were likely to contribute to the success of sleep interventions. Busch and colleagues (Busch et al., 2017) investigated the theoretical underpinning and methodology of each intervention; they concluded that interventions that were based on the transfer of learning principle, adopted the ecological approach (for example, intervention setting to include both school and home) and were integrated with multiple behavioural change strategies as components were more likely to be successful. In addition, Blunden and colleagues (Blunden et al., 2012) argued that sleep knowledge was the key component to a successful sleep education programme.

Both Blunden et al. (2012) and Busch et al. (2017) concluded that sleep interventions were most effective in enhancing sleep knowledge and generally useful in increasing sleep duration, although mixed results existed in the studies they reviewed. Sleep interventions were less successful in changing sleep-related behaviours (for example: sleep hygiene practices and sleep habits). The effects of sleep interventions on other sleep parameters, such as daytime sleepiness, and sleep quality were mixed and interventions were the least effective in improving other sleep-related variables, such as mood and motivation.

None of the studies included in the meta-analyses contained learning outcomes or aspects of cognition (e.g., executive functioning) as outcome variables. As discussed in the previous chapter, sleep problems affect learning capacity, school performance, and neurobehavioral functioning among school-aged children (Sadeh et al., 2002; Vriend et al., 2013). Therefore, it is necessary to explore the literature on sleep interventions further and examine whether studies on sleep intervention include outcome variables other than sleep parameters.

In addition, most studies that evaluated in-school sleep education programmes involved children who did not have identified disabilities and were considered to be generally healthy. Schools often comprise children with diverse needs; for example, children with mental health issues (e.g., anxiety), children who have experienced trauma (e.g., natural disasters) and children with health concerns (e.g., asthma, obesity). Studies reviewed in the above meta-analyses to date had not identified the characteristics of the child study populations that might relate to the presence of sleep problems. Thus, the need for sleep intervention, or the number of children with sleep related problems who improved, is not able to clearly be identified in a study of the effects of such programmes.

Individual Studies of Sleep Interventions with Children

A literature review that aimed to explore sleep interventions that specifically targeted primary school-aged children was carried out. The literature review criteria comprised: (a) children between the ages of six to twelve years, (b) children with reported sleep problems and (c) studies published since 2011, and therefore not included in the Blunden et al (2012) meta-analysis. Although the primary focus was on reviewing the literature on sleep education programmes, the review was extended to include sleep interventions that were not limited to school-based sleep education programmes. The reasons for this included: (i) there were very few studies being published since Busch and colleagues' meta-analysis study (Busch et al., 2017) that investigated school-based sleep education programmes on school-aged children; and (ii) both Blunden et al. (2012) and Busch et al. (2017) identified the need for a more substantial number of studies.

As a result, a search in the literature returned eleven suitable studies published from 2011 to 2020. These are reviewed and discussed in the following section, arranged in time order of publication date.

Paine and Gradisar (2011) set out a study to evaluate the efficacy of multicomponent Cognitive Behavioural Therapy Strategies in improving sleep, insomnia symptoms and adaptive functioning. The study adopted a randomised controlled trial design. Forty-two children diagnosed with Behavioural Insomnia of Childhood but no other medical sleep disorder or with ADHD symptoms or any developmental delay were recruited in the study. They were randomly assigned to the CBT intervention group or a wait-list control group. The mean age of the children was 9.3 years old.

The intervention components included sleep education, bedtime, sleep hygiene, thought challenging, graduated exposure to night-time separation from parents and teaching children relaxing and coping self-talk skills. Trained sleep therapists and psychologists provided children and parents with six individual Cognitive-Behavioural Treatment sessions in eight weeks. The first four sessions were held weekly, and the last two were delivered fortnightly. Each session lasted for 45 to 60 minutes. Between each session, children were required to practice the skills they learned during the previous session with parents' assistance. Children's sleep efficiency, sleep onset latency, wake after sleep onset and total sleep time (sleep duration) were measured using sleep diaries and actigraphy. Self-reported daytime sleepiness was measured using the Paediatric Daytime Sleepiness Scale. The frequency and severity of sleep onset complications and bedtime resistance were measured as insomnia disorder features. Anxiety symptoms, obsessive-compulsive disorder symptoms and depression were measured as indications of

children's adaptive functioning. Measurements took place at four time-points: baseline (T1), immediately after treatment (T2), one-month follow-up (T3) and six-month follow-up (T4).

Compared with children in the wait-list control group, after the intervention, improvements in sleep efficiency, sleep onset latency and wake after sleep onset were observed from children in the intervention group (Paine and Gradisar, 2011). These improvements were maintained at both follow-up time points. No effect was found on total sleep time. Reduction in insomnia disorder features and anxiety symptoms were observed. These improvements were maintained at both the one-month and the six-month follow-up.

Paine and Gradisar (2011) also conducted within-group analyses of children in the intervention group. They stated that Cognitive Behavioural Treatment (CBT) had positive effects on improving children's sleep parameters and reducing daytime sleepiness. Improvements were found on sleep efficiency (actigraphy d = 1.75, sleep diary d = 0.95), shortened sleep onset latency (actigraphy d = 1.62, sleep diary d = 1.04) and shortened wake after sleep onset (actigraphy d = 1.10, sleep diary d = 0.94). The improvements were maintained at one-month follow-up (sleep efficiency T1-T3: actigraphy d = 1.85, sleep diary d = 0.91; sleep onset latency T1-T3: actigraphy d = 1.54, sleep diary d = 1.10; wake after sleep onset T1-T3: actigraphy d = 0.98, sleep diary d = 0.88); and at six-month follow-up, where measurements were administered by sleep diaries only (sleep efficiency T1 – T4: d = 0.91, sleep onset latency T1 – T4: d= 0.88, wake after sleep onset T1 – T4: d = 0.77). The intervention generated small to moderate effect sizes on daytime sleepiness (T1 – T2: d = 0.45, T1 – T3: d = 0.79). No significant effect size for improvement of total sleep time was reported.

In addition, the intervention showed positive effects in reducing insomnia severity (Paine & Gradisar, 2011). Overall large effect sizes were reported among improvements in sleep onset

complications following the sleep intervention (d ranged from 1.08 to 3.31). These improvements were maintained at both follow-up points (T1 – T3 d ranged from 1.35 to 3.06, T1 – T4 d ranged from 1.15 – 2.85). Moderate to small effect sizes were reported on bedtime resistance post-intervention and at both follow-up time points (T1 – T2 d = 0.60, T1 – T3 d = 0 .49, T1 – T4 d = 0.12).

Paine and Gradisar (2011) found that the CBT intervention positively affected some aspects of adaptive functioning and in an overall reduction in children meeting diagnostic criteria. Overall, medium to large effect sizes were observed to (Cohen's d ranged from 0.42 to 1.20) reduce anxiety symptoms, obsessive-compulsive disorder symptoms and depression symptoms. The proportion of children in the intervention group that met the Behavioural Insomnia of Childhood diagnostic criteria dropped from 100% to 14.3% following the intervention and continued to decrease to 9.52% at one-month follow-up. At six-month follow-up, none of the children in the intervention group met the criteria.

Paine and Gradisar (2011) stated that the combination of behavioural sleep medicine and anxiety-based techniques largely improved children’s sleep behaviour while reducing some aspects of adaptive functioning. This study did not include any measures of cognitive function, or day-time mood and functioning. In addition, the study required highly trained therapists and psychologists to implement the intervention. Overall, the authors believed that their study provided evidence for the efficacy of a CBT intervention in treating paediatric insomnia.

Byars and Simons (2014) evaluated the efficacy of sleep behavioural intervention in treating paediatric insomnia in clinical practice. The study aimed to demonstrate the clinical use of the empirically supported treatment for paediatric insomnia. The study was a clinical summary. From June 2009 to December 2012, 509 children and adolescents (mean age = 7.5 years old)

with a diagnosis of insomnia were referred to the Behavioural Sleep Medicine Clinic (BSMC), a unit located in a tertiary care pediatric hospital, for treatment.

The primary treatment provided at the BSMC was Cognitive Behavioural Therapy (CBT). Different CBT modalities were applied to different individuals based on children's diagnosis and family conditions. The modalities used for the treatment included unmodified extinction, graduated extinction, extinction with parent presence, positive routine, faded bedtime, bedtime pass, scheduled awakenings, stimulus control therapy, relaxation training, cognitive restructuring, sleep restriction and multicomponent CBT. The authors did not report the average session number and session lengths due to the nature of individualised treatment modalities. The Pediatric Insomnia Severity Index (PISI) developed by the study authors was used to assess treatment outcome. It was completed as a self-report for those who were older than ten years of age. Parents completed the questionnaire when the child was younger than ten.

Byars and Simons (2014) reported that children who received treatment had a significant decrease in insomnia severity, as reflected in the PISI scores ($p = 0.000$). They stated that significant improvement was observed within four sessions (in less than twelve weeks) in most treatment. The follow-up rate was around 30%, and those who completed follow-up were showing better treatment outcome. Younger children responded to treatment better than preadolescents and adolescents.

Byars and Simon (2014) argued that the study was critical in providing insights into the clinical literature in treating childhood insomnia using CBT. They suggested that individual and family circumstance should be better understood in preparing for alternatives to follow-up for future clinical practice. The authors (Byars & Simon, 2014) stated that most childhood insomnia

research was conducted with children under four. Studies including school-aged children and adolescents were desirable for the guidance of clinical practice in the future.

Tamura and Tanaka (2014) evaluated the effectiveness of a self-help sleep education intervention. The study adopted a randomised controlled trial design. One hundred and forty-eight healthy elementary school students ($N_{girl} = 69$) from grade four to grade six participated in the study.

The intervention components included a sleep knowledge check quiz, a 45-minute sleep hygiene class provided by the sleep instructor, and a self-help sleep behavioural change checklist. During the class, students were asked to choose a target sleep behaviour from the checklist that they wished to change during the class. Students were then required to practice the target sleep behaviour by themselves in the following two weeks.

Outcome variables measured in the study included bedtime, sleep duration, sleep-related behavioural change, and daily functioning. These were measured using self-reported sleep diaries and checklists. Measurements took place at three-time points: before the sleep hygiene class, immediately after the class and two weeks after the class.

Tamura and Tanaka (2014) found a significant increase in sleep knowledge ($p = 0.002$, $d = 0.57$) and earlier bedtime (advanced by seventeen minutes) in the treatment group across all grades. The average sleep duration among students in the treatment group increased by fourteen minutes. A significant change was found in sleep-related behaviours, including establishing a regular daily rise time ($p < 0.01$), limiting screen time before sleep ($p < 0.01$), and avoiding exposure to light before bed ($p < 0.05$). The study authors further analysed the association between sleep (bedtime and sleep duration) with sleep-related behaviour and found that three sleep-related behaviours positively impacted sleep. They were setting a regular rise time,

limiting screen time, and avoiding napping after school. Tamura and Tanaka (2014) also found that early bedtime improved mood ($p < 0.05$) and reduced irritability ($p < 0.05$) in the morning. They discussed that good sleep hygiene based on sleep-related behaviours was the foundation of improving sleep and preventing inadequate sleep. Tamura and Tanaka (2014) also included measurement of daytime functioning; they found that the intervention group reported significant improvements in irritability ($p < 0.01$), complaining of poor sleep ($p < 0.05$); and deteriorated mood in the morning ($p < 0.01$) after sleep education.

The study authors believed that a school-based sleep programme with self-help treatment that including having children select the behaviours they wish to change and self-practising the target behaviour was effective in improving children's sleep knowledge and sleep-related behaviours. They suggested that sleep knowledge that was closely paired with sleep-related behaviours was more effective for improving sleep duration and bedtime. They stated that some of the major limitations of their study included the lack of a follow-up measurement, which limited the evaluation of the intervention's long-term effect. Another limitation was that children's sleep quality was not evaluated. They suggested future research studies to evaluate the long-term effect of the self-help sleep programme and include sleep quality in the measurement.

Willgerodt and colleagues (Willgerodt, Kieckhefer, Ward, & Lentz, 2014) set out a qualitative study to investigate the effectiveness of an individualised and motivational-based sleep intervention among school-aged children. Nine children between the age of eight to eleven participated in the study. All of them were reported getting inadequate sleep by their parents. Among the nine children, two had a diagnosis of asthma, two of Attention-deficit Hyperactivity

Disorder (ADHD), and one with a mild learning disability. The total study period lasted eight weeks.

For the first three weeks, each child and the parents attended a fifteen-minute individual session with one of the study authors at a clinic every week. During the first session, the study author obtained formal consent from the parents and the child; the parents completed the Child's Sleep Habits Questionnaire (CHSQ), whereas the child completed the Sleep Self-Report (SSR). The study author explained the actigraphy and the sleep diaries. The child and the parents were required to complete the sleep diaries for seven consecutive days while wearing the actigraph device for the same period during days and nights. During the second session (the second week of the study period), the parents completed the Eyberg Child Behavior Inventory (ECBI) and returned the seven-day sleep diaries and the actigraph device to the study author. The study author delivered the intervention by discussing the child's sleep concerns with the parents and the child; sharing age-appropriate sleep knowledge; reviewing and discussing the sleep data from the sleep diary and the actigraphy data; identifying target sleep behaviour that the child and parents wished to change, and to set an individualised plan. The child and the parents were given a set of blank seven-day sleep diaries and a pre-programmed ready-to-use actigraph device at the end of the session for the second round of sleep data collection in the following seven days. At the third session, the parents completed another ECBI and handed in the sleep diaries and actigraph device. The study author reviewed the sleep data, adjusted and refined the target sleep behaviour written on the individualised plan with the child and the parents. The child and the parents were given another set of sleep diary, the re-programmed actigraph device, and a stamped envelope. The sleep diaries and the actigraph device were mailed back to the study author after the child, and the parents completed the seven-day sleep data recording. The study

author provided written feedback to the child and the parents upon receipt of the sleep data, and these were mailed back to them. After a month, the child and the parents received another set of blank sleep diaries and an actigraph device for the final seven-days of sleep data recording. Once completed, the sleep diaries and the actigraph device were sent back to the study authors for comment. The data were mailed back to the family with written comments.

Complete data were available from six of the nine children who completed the study. Actigraphy data indicated that of the six children, two children's sleep duration increased more than 30 minutes on half of the nights from baseline towards the end of the eighth week; two children had an average increase of more than 30 mins across 42% of the nights; and two children had an average increase of more than 30 mins across 25% of the nights.

In terms of sleep-related variables, all six children's parents reported that the target behaviours were achieved post-intervention, these included earlier bedtime, no intense play before bed, and no co-sleeping. Five out of the six children's parents reported improvement or stabilisation in their children's problem behaviours after three sessions. Feedback from parents reported changes in children's sleep behaviours, for example stabilized bedtime, earlier bedtime, awareness of sleep (Willgerodt et al., 2014).

Willgerodt et al. (2014) believed that this motivational-based sleep intervention was likely to be effective in changing sleep hygiene practices by having the child and the parents co-manage the target sleep behaviour. The authors further suggested that the intervention was suitable to be replicated in the community due to its fewer session numbers (three sessions in person and two mail by correspondence) and shorter session times (fifteen minutes per session).

Hiscock and colleagues (Hiscock et al., 2015) conducted a study to examine whether behavioural strategies aiming to improve sleep among children with ADHD could also improve

their symptoms, behaviour, daily functioning, and working memory. The study adopted a randomised controlled trial design. Two hundred and forty-four children with the diagnosis of ADHD, who also had an identified sleep disorder or anxiety leading to insomnia, but no other serious medical condition, disability or sleep apnoea, were recruited in the study. None were receiving sleep assistance at the time of recruitment.

The intervention consisted of behavioural strategies such as ignoring and rewarding, delayed sleep onset latency, bedtime fading, visual imagery and relaxation techniques, etc. These strategies were delivered to the child and the family based on individual needs. The intervention programme lasted for six weeks. Children and their families in the intervention group received one consultation every two weeks. The first two sessions were delivered individually by the psychologists at their practices (e.g., clinic, paediatrician's office, or home). A follow-up call was given to the intervention group two weeks after the second session. During the first session, the psychologists assessed the child's sleep problem, provided information on sleep (e.g., sleep knowledge, sleep hygiene, sleep cycle), set the child's sleep goal with the parents, and developed a sleep management plan accordingly. Parents were required to record the child's sleep and sleep management progress using the sleep diaries. The second session and the follow-up call served to review the sleep diaries, reinforce the sleep management strategies, and answer questions.

Hiscock and colleagues (Hiscock et al., 2015) found that children in the intervention group showed a significant reduction in sleep difficulties at both three-month (d = 0.8) and six-month follow-ups (d = 0.6). Reduction in behavioural difficulties (three-month: d = - 0.5; six-month: d = - 0.4), improvement in the quality of life (three-month: d = 0.7; six-month: d = 0.4); and improvement in daily functioning (three-month: d = -0.6; six-month: d = -0.4) were also

reported by the authors at both follow-up time points. Regarding ADHD symptoms, a significant difference was found between the intervention and the control children in parent-report but not in teacher's report.

Hiscock et al. (2015) suggested that the study provided insights for applying brief behavioural strategies for sleep problems in children with ADHD. The sustained outcomes were comparable with intensive behavioural interventions targeting ADHD symptoms. The relatively brief intervention was easily replicable in a similar setting. They further discussed some study limitations, mainly the low family response rate at both follow-up time points. Hiscock and colleagues (Hiscock et al., 2015) believed that the study had clinical implications for applying cost-effective treatment to children with ADHD who exhibited sleep problems. Further research could study the possibilities of pathways of translating such benefits to the community-based practice.

Mindell and colleagues (Mindell et al., 2016) delivered a programme that aimed to improve parental knowledge and attitudes around healthy paediatric sleep habits among socioeconomically disadvantaged children. The study adopted a randomised controlled trial design. One hundred and fifty-two children from low-income families who did not have a proper bed to sleep in at night were recruited into the study. The average age of the children was 5.95 years. All study children were given a bed. The children from the intervention group received the Sleep Well! Sleep Hygiene Education while the control group received a dental hygiene education programme.

The intervention included three messages for parents to implement with their children: "(1) have a bedtime before 21:00, (2) avoid all caffeine, and (3) keep electronics out of the bedroom" (Mindell et al., 2016, pp. 1594). These messages were delivered to parents in the intervention

group at three time-points. First, they were given verbally on the phone while confirming the delivery of beds by the study authors. Second, they were printed on the information sheets, on a bookmark, and on a refrigerator magnet and were given to the families with the beds' delivery. Third, the study authors restated messages over the phone four weeks after the beds' delivery. Children's sleep duration, bedtime, caffeinated beverage consumption and the number of electronics in the bedroom were reported by parents using the questionnaire provided by the authors. Parents reported this information to the study authors over the phone while confirming the delivery of beds (Time 1) and four weeks after the delivery of the beds (Time 2).

Mindell and colleagues (Mindell et al., 2016) reported an improvement in average sleep duration for children in the intervention group (from 9.75 hours to 10.19 hours; $p = 0.04$). No significant effect on children's bedtime was observed. Caffeinated beverage intake reduced by 0.37 items ($p = 0.08$) at Time 2 for the intervention group. The study authors reported a strong association between providing a bed and reducing electronics in children's bedrooms for all participants ($F = 50.47$, $p < 0.001$). The association was stronger for children in the intervention group (from 1.91 items at baseline to 0.85 item at follow-up, $p < 0.001$). The proportion of children with zero electronics in their bedrooms increased significantly for both groups (intervention group: baseline 8.9% to follow-up 34.5%, $p <0.001$; control group: baseline 11.3% to 24.5% follow-up, $p = 0.04$).

Mindell and colleagues (2016) argued that the simple sleep hygiene intervention consisted of three short messages that can be effective when combined with the modification of children's sleep environments, in this case, providing a bed. They believe that by providing a bed to low-income families, children's sleep environments were significantly improved, which substantially assisted some aspects of children's sleep hygiene practices and facilitated sleep duration. They

also considered that some sleep hygiene practices such as “no electronics in the bedroom” was more likely to be achieved with the improvement of sleep environment than “no caffeine” or “bedtime before 21:00”, which appeared to be built around individual household routine and activities.

Gruber and colleagues (Gruber, Somerville, Bergmame, Fontil, & Paquin, 2016) conducted a study to examine whether the Sleep for Success (SFS) sleep intervention programme had a positive impact on children’s sleep duration, sleep efficiency, sleep latency and/or report-card grades. The study adopted a non-randomised controlled trial design. Seventy-one healthy children with a mean age of 8.46 years participated in the study.

The intervention was developed using a collaborative approach with the involvement of researchers, schools, teachers, parents and students. The SFS programme consisted of four modules. (1) The Sleep Knowledge and Education module included grade-appropriate information on sleep hygiene, sleep routine, and positive and negative consequences of sufficient and insufficient sleep. (2) The Family and Community Involvement module was comprised of parent’s letters that contained SFS activity information, parents' information sessions held in the schools and homework activities from the SFS that required parents’ participation. (3) The Sleep Promotion for Staff module was a workshop for teachers and school staff on children’s sleep and academic performance. Teachers were provided training on the Sleep Knowledge and Education module with the Teacher Activity Guide. The teachers then delivered six interactive lessons to their pupils, each lesson was about two hours in length, delivered once per week over six weeks. (4) The Sleep-friendly School Environment module targeted school principals, aiming to promote sleep knowledge and create a potential sleep-friendly school environment.

Sleep duration, true sleep time, sleep efficiency and sleep latency were measured by actigraphy and sleep diary two weeks before the intervention and post-intervention. Report-card grades in physical education, mathematics and English were collected before and after intervention.

Gruber and colleagues (2016) reported an overall improvement in sleep parameters (eta-squared = 0.18). For children in the intervention group, average true sleep time increased by 18.2 minutes ($p < 0.03$), sleep efficiency increased by 2.33% ($p < 0.03$) and sleep latency shortened by 2.32 minutes ($p < 0.001$). Although average sleep duration was increased by 7.58 minutes, it did not reach statistical significance. The researchers argued that the findings in true sleep time were consistent with studies conducted on sleep extension associated with daytime functioning, sustained attention, and children's functioning at school among primary school children.

Gruber et al. (2016) found overall improvement in academic performance (eta-squared = 0.16), in mathematics ($F1,69 = 8.55$, $p < 0.004$) and in English ($F1,69 = 4.58$, $p < 0.05$), which were consistent with their previous study finding which demonstrated association between sleep efficiency and children's performance on Mathematics, English and French in primary school.

Gruber and colleagues (2016) argued that theirs was the first study to explore the impact of a sleep intervention programme on academic performance among primary school children. According to the study authors, their study's major limitation was the lack of a follow-up period. They suggested that future sleep intervention programmes that were designed with developmentally appropriate content for teacher delivery in a classroom would overcome some of the barriers in engaging teacher's willingness to deliver sleep education sessions in addition to a regular teaching curriculum.

Ashton (2017) conducted a study to evaluate the effect of the Australian Centre for Education in Sleep (ACES) programme junior version with primary school children. The study aimed to examine whether this intervention would produce sustained changes in children's sleep knowledge and sleep behaviours. The study adopted a quasi-experimental design.

The ACES programme was developed based on The Theory of Planned Behaviour, which required children to make their own choices in changing specific sleep behaviours/sleep habits. The study used the ACES Junior materials provided by the original authors of the ACES programme, and it was modified to suit the UK context (Ashton, 2017).

The intervention included three lessons covering topics on normal sleep, sleep hygiene, and sleep problems; a project that aimed to consolidate the knowledge acquired from the three lessons; and one booklet for parents. Teachers received a training session on how to deliver the intervention before providing the intervention to the children.

Two hundred and twenty children between the ages of nine to ten in a single-year group from seven primary schools were recruited; among them, 113 children were assigned to the control group, who received a delayed intervention. All participants were asked to complete a seven-day sleep diary, a ten-item questionnaire on sleep knowledge for each measurement time point: before the intervention, post-intervention (five weeks from pre-intervention), and eight to twelve weeks follow-up. Ashton (2017) did not report the total number of children who consented to wear actigraphs. The independent variables measured at three time-points were: time in bed, time asleep, sleep efficiency, and sleep knowledge.

Due to the insufficient data return issue, Ashton (2017) managed to analyse time asleep and sleep efficiency using only the weeknights actigraphy data. Compared with baseline, improvement in average time asleep among the intervention group (n = 25) was reported by

11.16 minutes (d = 0.30), whereas improvement in average sleep efficiency was small (d = 0.38). The improvements found in average time asleep and average sleep efficiency were not maintained at follow-up. On the other hand, Ashton (2017) found that sleep knowledge was improved following the intervention, and the improvement was maintained at follow-up for the intervention group.

Ashton (2017) stated that based on the findings, the ACES programmes appeared to have little significant effect on improving total time asleep or sleep efficiency than was otherwise found in studies with older children implementing the ACES programme. She argued that the study might be one of the few studies that focused on pre-adolescent children. The author discussed that the lack of significant improvement in time asleep and sleep efficiency might be due to low frequency and low intensity of implementing the intervention and lack of active parental involvement. She also suspected that compared with their peers who did not receive sleep education, those who had sleep education might start to see a change in their sleep behaviours when entering adolescence, where a decline in sleep duration is often observed. Ashton (2017) also pointed out that sleep interventions based on motivational interviewing, self-determination theory or making actual changes to school rules (for example, delay the school start time) might be useful in changing children's sleep behaviours.

Schlarb and colleagues (Schlarb et al., 2018) conducted a study in Germany to examine the efficacy of a Cognitive Behavioural Intervention for Insomnia (CBT-I) programme named the KiSS Programme (Training Für Kinder mit Schlafstörungen), which was specially designed for children from five to ten years of age. The study aimed to evaluate the effectiveness of the KiSS programme in the following areas: whether the programme effectively eliminated the number of children meeting the diagnostic criteria, improved sleep parameters, and if so, whether the effect

was maintained over twelve months. The study adopted a randomised controlled trial design. One hundred and twelve children (M = 8.1 yrs) and their families (M = 37.7 yrs) participated in the study. All children recruited were diagnosed with sleep disorders based on the International Classification of Sleep Disorders; and were assigned to an intervention group or a wait-list group on a 4:1 ratio order. Children with mental disorders were excluded.

The KiSS programme contained strategies common to most CBT-I programmes. Sleep restriction, stimulus control therapy, sleep hygiene, relaxation and cognitive therapy were implemented via different sessions. The clinician provided six group sessions over three weeks. Children and their families each received one session per week. Each session lasted 100 minutes.

The first parent session included information on sleep, sleep hygiene, sleep restriction, graduated extinction and cognitive strategies addressing false beliefs about children's sleep that the parents may have held. The second parent session delivered information on stimulus control techniques, how to implement sleep-related rules and identifying children's intention associated with sleep-related behaviour. The last parent session focused on reconsolidation of all the strategies learned from the previous sessions.

During the child sessions, in the first session, children were provided with information on sleep and sleep hygiene and were taught relaxation techniques. The following session helped children to use imaginary metaphors and elements in sleep-related hypnotherapy. The last session incorporated all the strategies learned previously.

The researchers measured sleep parameters including sleep onset latency, sleep efficiency, frequency of awakening, total sleep time and sleeping the parent's bed. These were measured with sleep diaries and actigraphy. Children's sleep behaviours were evaluated from the

Children's Sleep Habits Questionnaire (CSHQ-DE) (completed by parents) and the Sleep Self-Report (SSR-DE) (completed by children). Children's daytime sleepiness was assessed with the Epworth Sleepiness Scale for Children (ESS-C-ED) (completed by both the parents and the child). Measurements were taken at five-time points: pre-treatment, immediately after treatment, three-month follow-up, six-month follow-up and twelve-month follow-up.

Overall, Schlarb and colleagues (Schlarb et al., 2018) reported a reduction in children meeting the diagnostic criteria for sleep disorders and improved sleep parameters for children in the intervention group. The proportion of children who met the criteria for a sleep disorder decreased from 100% to 49.3% after the intervention. Small effect sizes were reported for sleep onset latency (sleep diary: d = 0.27; actigraphy: d = 0.24); and frequency of awakening (sleep diary: d = 0.33; actigraphy: d = 0.33). A small effect size was found on sleep efficiency measured by actigraphy only (d = 0.39). Moderate effect sizes were reported on total sleep time measured by actigraphy (d = 0.51) and weekly frequency of co-sleeping with the parents measured by sleep diary (d = 0.75). Large effect sizes were reported on CSHQ-DE total score (d = 1.31), and SSR total score (d = 0.81). A small effect size was found on parent-reported daytime sleepiness (d = 0.46).

At 12-month follow-up, the effectiveness of the programme was maintained (Schlarb et al., 2018). The proportion of children who met criteria for a sleep disorder had further decreased to 27.2%. Further improvements were reported for sleep onset latency (sleep diary: d = 0.49; actigraphy: d = 0.39); frequency of awakening (sleep diary: d = 0.64), and total sleep time (actigraphy: d = 0.46). A large effect size was reported for improved sleep efficiency (actigraphy: d = 0.96; sleep diary: d = 0.65). A moderate effect size was reported for reduced co-sleeping with parents (sleep diary: d = 0.77). Large effect sizes were reported for CSHQ-DE

total score (d = 1.72), and SSR total score (d = 1.28). Small effect sizes were reported for daytime sleepiness (parent report: d = 0.70; child report: 0.44).

According to the authors (Schlarb et al., 2018), the study suggested that the KiSS programme had an immediate and long-term positive effect on improving sleep and sleep behaviour and reducing the proportion of children with sleep disorders. Schlarb and colleagues (Schlarb et al., 2018) argued that the reduction reported in sleep onset latency was consistent with previous findings published in studies conducted in younger children and school-aged children. Moreover, the lack of improvement in total time sleep was also in line with results reported in cognitive-behavioural treatment for insomnia among school-aged children.

The authors (Schlarb et al., 2018) also reported the following limitations of the study. The effect of individual components of the treatment on sleep outcomes cannot be evaluated since they were delivered as a whole. The results cannot be generalised to the general population due to the exclusion of children with mental health problems. Half of the families did not complete the twelve-month follow-up.

Schlarb and colleagues (Schlarb et al., 2018) recommended future research to include parent feedback on the treatment components for individual evaluation. Non-responding children's characteristics should be examined and explored to develop a suitable intervention that specifically targets this group of children. This study is also limited because it did not explore the effects of the sleep intervention on children's cognition.

Maeda, Oniki, and Miike (2019) reported the effects of a sleep education programme on children's future school refusal behaviour. From 2007 to 2014, a total of 795 children between the grades of one to six from a primary school in Japan participated in this longitudinal study. The sleep education programme was based on the biochronological rhythm. The components of

the sleep education programme included: (a) a daily life rhythm survey, which was a self-recorded sleep rhythm table that contained a child's self-reported sleep for fourteen consecutive days, (b) a list of conditions used to identify children's irregular sleep pattern from children's daily life rhythm survey. Those children who reported irregular sleep pattern were allocated for intervention. (c) interviews for the children who required intervention, with their parents, (d) life rhythm lectures for parents and teachers, (e) a 45-minutes in-class sleep programme. The authors did not provide further details on how the intervention was delivered or who administered/delivered components (b), (c), (d), and (e) of the intervention. It was not clear whether only the children who showed irregular sleep pattern participated the full programme or that all children participated some parts of the programme as the authors did not give details.

Self-report was used as sleep measurements, whereas future school refusal status was reported by the school. Outcome variables included sleep onset time, sleep duration, and school refusal status. No details on measurement-points were given.

Maeda et al. (2019) reported a general trend of improved sleep duration and sleep onset time. Compared with baseline 2007, children went to bed earlier each following year, and the average sleep onset time in each following year was closer to the recommended bedtime of 9:30 pm. The average sleep duration was increased in each following year since baseline 2007. The percentage of future school refusal status, that was those children who received intervention showing school refusal behaviour after entering junior high school, decreased from 10.9% at baseline 2007 to about 2.7% in 2008 (the year where the 6th grade who received sleep education programme entered junior high school). It continued to improve till 2012, where no school refusal status was reported (0%), and the improvement was maintained for 2013.

Maeda and colleagues (Maeda et al., 2019) believed that the sleep education programme was effectively helped children and parents understand the importance of daily life rhythm and sleep. Furthermore, they stated that their study results indicated that future school refusal behaviour could be minimized by addressing age-appropriate sleep needs and modifying inappropriate sleep patterns at an early stage. They suggested that early intervention in the form of providing sleep education to regulate sleep-wake rhythm was essential and useful in diminishing future problem behaviours at school and promoting healthy physical and social development in children.

Rey and colleagues (Rey et al., 2020) investigated the effectiveness of a school-based sleep education programme on children's sleep, cognitive performance and academic achievement. The study adopted a within-subjects design. One hundred thirty primary school children (N_{girl} = 62) between the ages of eight to nine years (M_{age} = 8.43 years old, SD = 0.29) were recruited from five schools in France. Only typically developing children who did not report sleep disorders were included in the study.

The sleep education programme comprised a teacher's training manual that included detailed sleep information, full descriptions of eight structured sleep theme lessons, and seven sleep tips. Children were given a one-month nutrition education programme, which served as a control period, six to seven weeks prior to the sleep education programme. Eight sleep themed lessons were delivered by the teachers twice a week during regular school hours; each lesson lasted fifty minutes. At the end of each lesson, a sleep-tip was given to the children. The sleep education programme adopted a multidisciplinary and collaborative approach.

The study authors used objective measurements of sleep. Each child was given an actigraph for the measurement of sleep. Sleep variables included bedtime, wake-up time, time in bed, total

sleep time, sleep onset latency, sleep efficiency, wake after sleep onset, and mid-sleep. Variables of cognition included inhibitory control, cognitive flexibility, mental planning, running span, memory recognition, sustained attention, and a global score. Academic performance was measured by grade reports. Parents' knowledge of sleep was measured by a questionnaire. Measurements took place at five time-points: one-week before the delivery of the nutrition education programme (T1); one-week after the nutrition programme (T2); one-week before the sleep education programme (T3); one-week after the sleep education programme (T4); and one year after the sleep education programme (T5). Academic performance and parents' knowledge were measured at T3 and T4 only, whereas the rest of the outcome variables were measured at all five time-points.

Rey and colleagues (Rey et al., 2020) reported improvement on all sleep variables. In particular, the mean time in bed increased by nineteen minutes before and after the sleep education (T3 Mean = 570.8, SD = 3.0, Vs. T4 Mean = 589.4, SD = 2.6), and the improvement was maintained after one-year (T5 Mean = 583.2, SD = 2.4). Sleep efficiency also improved by 2.9% after sleep education, and the improvement was maintained at follow-up. Compared with T3, improvements on all cognitive variables except for memory recognition were observed at T4, and the improvements were maintained at T5. No change in academic performance was reported. Parents' sleep knowledge improved after sleep education.

The authors believed that their sleep education programme was effective in improving sleep duration and sleep efficiency, which produced improvement in cognitive performance, especially in executive functioning and attention. They argued that sleep education programmes that involved multiple key stakeholders in children's lives were most likely to promote long-term benefits, as was shown in their current study.

The major limitation Rey and colleagues (Rey et al., 2020) reported about their study was the lack of change in the memory recognition task. They stated that tasks involving a higher cognitive load than the task being used in the current study might be a better tool to assess memory gain.

Summary of the individual studies.

Study characteristics. Eleven studies published from 2011 to 2020 were selected and reviewed. Three out of these were conducted in the United States (Byars & Simon, 2014; Mindell et al., 2016; Willgerodt et al., 2014), two in Australia (Hiscock et al., 2015; Paine & Gradisar, 2011), two in Japan (Maeda et al., 2019; Tamura & Tanaka, 2014), one in Canada (Gruber et al., 2016), one in the UK (Ashton, 2017), one in Germany (Schlarb et al., 2018), and one in France (Rey et al., 2020).

The experimental design of the eleven studies varies. Five entailed randomised controlled trial designs (Hiscock et al., 2015; Mindell et al., 2016; Paine & Gradisar, 2011; Schlarb et al., 2018; Tamura &Tanaka, 2014), one used a non-randomised controlled trial design (Gruber et al., 2016), one adopted a quasi-experimental design (Ashton, 2017), one used a within group design (Rey et al., 2020), one study was a longitudinal study (Maeda et al., 2019), one study was a qualitative study (Willgerodt et al., 2014), and one was a clinical summary (Byars & Simon, 2014). Group comparisons were used in eight of the eleven studies. Of which, four used a waitlist control group (Hiscock et al., 2015; Paine & Gradisar, 2011; Schlarb et al., 2018; Tamura &Tanaka, 2014); three used control group (Ashton, 2017; Gruber et al., 2016; Mindell et al., 2016) and one used early termination group (Byars & Simon, 2014). Five studies measured follow-up, with periods ranging from one to twelve months (Ashton, 2017; Hiscock et al., 2015;

Paine & Gradisar, 2011; Rey et al., 2020; Schlarb et al., 2018). The number of participants in the individual studies ranged from nine to 509.

In terms of child characteristics, three of the eleven studies were designed for primary school children with the diagnosis of insomnia (Paine & Gradisar, 2011; Byars & Simon, 2014; Schlarb et al., 2018). Six were conducted with general children in primary school (Ashton, 2017; Gruber et al., 2016; Maeda et al., 2019; Mindell et al., 2016; Rey et al., 2020; Tamura &Tanaka, 2014). Two studies included children with identified disabilities (Hiscock et al., 2015; Willgerodt et al., 2014). The average age of the participants in studies ranged from seven and a half to twelve years old.

Characteristics of Sleep Interventions. One of the most critical considerations in intervention design is the theoretical underpinning of the intervention strategy and intervention components. As identified by the study researchers, four studies evaluated Cognitive Behavioural Therapy (CBT) based sleep interventions (Byars & Simon, 2014; Hiscock et al., 2015; Paine & Gradisar, 2011; Schlarb et al., 2018). Of the remaining sleep education programmes, one was based on the Therapy of Planned Behaviour (Australian Centre for Education in Sleep - ACES, Ashton, 2017); one was constructed by a community-based participatory research approach and experiential learning approach (Sleep for Success programme, Gruber et al., 2016), one was based on biochronological rhythms (Maeda et al., 2019), one adopted a multidisciplinary and collaborative approach (Rey et al., 2020); one was designed using self-help treatments (Tamura & Tanaka, 2014). The only qualitative study was based on motivational-based intervention (Willgerodt et al., 2014). One study did not mention the theoretical underpinning of the intervention (Sleep Well! Mindell et al., 2016).

The intervention components commonly found in the studies reviewed included sleep hygiene and sleep knowledge. Sleep hygiene was emphasized in all CBT based studies and all sleep education programme. All interventions excepted one (Mindell et al., 2016) included sleep knowledge as a component.

The intervention delivery differed based on the setting of the interventions. Five of the eleven interventions were delivered in a clinical setting (Byars & Simon, 2014; Hiscock et al., 2015; Paine & Gradisar, 2011; Schlarb et al., 2018; Willgerodt et al., 2014). Five in-school sleep education programmes included both school and home settings (Ashton, 2017; Gruber et al., 2016; Maeda et al., 2019; Rey et al., 2020; Tamura & Tanaka, 2014). One programme was delivered at home only (Mindell et al., 2016).

Of the five in-school sleep education programmes, two were delivered by teachers only (Ashton, 2017; Rey et al., 2020); one was implemented by trainers (Gruber et al., 2016); one was delivered by sleep instructors (Tamura & Tanaka, 2014); one was delivered by study authors (Mindell et al., 2016); one did not mention who delivered the programme (Maeda et al., 2019). The four CBT-based interventions were provided by trained professionals, including psychologists, psychologist trainees, clinicians, trained sleep therapists and study authors. The motivational-based interviewing programme was provided by Willgerodt and colleagues (Willgerodt et al., 2014).

The total duration, session duration and participants of each sleep intervention vary. The intervention duration ranged from two weeks (Hiscock et al., 2015; Tamura &Tanaka, 2014) to eight weeks (Paine & Gradisar, 2011; Willgerodt et al., 2014). Sessions ranged from one session (Tamura & Tanaka, 2014) to eight sessions (Rey et al., 2020).

Six of the eleven studies delivered intervention compoments to both children and their parents (Byars & Simon, 2014; Gruber et al., 2016; Hiscock et al., 2015; Paine & Gradisar, 2011; Schlarb et al., 2018; Willgerodt et al., 2014); three were provided to teachers and children (Ashton, 2017; Rey et al., 2020; Tamura & Tanaka, 2014); one was delivered to teachers, parents, and children (Maeda et al., 2019); one was implemented to parents only (Mindell et al., 2016).

Variables and measurements. Some common sleep variables were measured. Total sleep time/sleep duration was measured in eight of the eleven studies (Ashton, 2017; Gruber et al., 2016; Mindell et al., 2016; Paine & Gradisar, 2011; Rey et al., 2020; Schlarb et al., 2018; Tamura & Tanaka, 2014; Willgerodt et al., 2014). Sleep efficiency was measured in five studies (Ashton, 2017; Gruber et al., 2016; Paine & Gradisar, 2011; Rey et al., 2020; Schlarb et al., 2018). Sleep onset latency was measured in four of the eleven studies (Gruber et al., 2016; Paine & Gradisar, 2011; Rey et al., 2020; Schlarb et al., 2018). Insomnia severity was reported in Paine and Gradisar (Paine & Gradisar, 2011) and Byars and Simon (Byars & Simon, 2014). Sleep difficulties/sleep disturbance was measured in Hiscock et al. (Hiscock et al., 2015) and Schlarb et al. (Schlarb et al., 2018). Sleep-related behaviour was reported in four studies (Tamura & Tanaka, 2014; Willgerodt et al., 2014; Mindell et al., 2016; Schlarb et al., 2018).

Variables related to the impact of sleep were measured in some of the studies. These included school grades (Ashton, 2017; Gruber et al., 2016), school daytime functioning (Tamura & Tanaka, 2014), school refusal behaviour status (Maeda et al., 2019), working memory (Hiscock et al., 2015), areas of executive functioning (Rey et al., 2020), and parents' sleep knowledge (Rey et al., 2020). Three studies measured daytime sleepiness (Paine & Gradisar, 2011; Tamura & Tanaka, 2014; Schlarb et al., 2018). Some studies also measured variables

associated with mental health (Paine & Gradisar, 2011), behavioural and emotional problems (Hiscock et al., 2015; Willgerodt et al., 2014). Two studies did not measure any non-sleep variables (Byars & Simon, 2014; Mindell et al., 2016).

Researchers commonly used actigraphy (five studies) and sleep diaries (eight studies) to collect data on sleep efficiency, sleep onset latency, wake after sleep onset, sleep duration and time in bed. In addition to actigraphy and sleep diaries, researchers used checklists, questionnaires, and parents' feedback to collect additional information on sleep, and on non-sleep variables.

Analysis of individual studies. The analysis of the literature was undertaken to determine the practical effects of the sleep interventions, as opposed to their statistical significance based on sample size. According to Cumming (2011), effect size is an essential tool for analysis because it represents effects without the influence of sample size. To compare and evaluate each sleep intervention's efficacy in this chapter, the standardised mean difference effect size Cohen's d was calculated using the Campbell collaboration calculator (Wilson, n.d.). When means and standard deviations were reported in the original studies, means and standard deviations of variables of interest (mainly sleep parameters and cognition/aspect of cognition parameters) at baseline in the intervention group were entered as control variables, means and standard deviations of variables post-intervention in the intervention group were used as treatment variables.

Sleep variables and sleep-related variables. The effect size analyses indicated that CBT-based interventions were more effective for improving children's sleep, especially for addressing sleep concerns of children with insomnia. Immediate improvement of children's sleep onset latency was reported by Paine and Gradisar's study (2011) with large effect sizes (sleep diary d =

1.04, actigraphy d = 1.62). CBT interventions appeared to have a sustained positive effect on the improving children's sleep onset latency. This was showed in both Paine and Gradisar's (2011) study and Schlarb and colleagues' (Schlarb et al., 2018) study. Paine and Gradisar's (2011) reported large effect sizes at both one-month follow-up (sleep diary: d = 1.10, actigraphy d = 1.54), and at six-month follow-up (sleep diary: d = 0.88), whereas Schlarb et al (2018) reported small effect size at twelve-month follow-up (sleep diary: d = 0.49, actigraphy d = 0.39).

Immediate improvement of children's wake after sleep onset was reported by Paine and Gradisar's study (2011) with large effect sizes (sleep diary d = 0.94, actigraphy d = 1.10). The sustained positive effect was maintained at one-month follow-up (sleep diary d = 0.88, actigraphy d = 0.98) and at six-month follow-up: sleep diary: d = 0.77) (Paine & Gradisar, 2011).

Sleep efficiency responded well to CBT-based sleep interventions. Immediate improvement for sleep efficiency after sleep intervention was reported in Paine and Gradisar's (2011) study (sleep diary d = 0.95, actigraphy d = 1.75) and Schlarb et al's (2018) study (actigraphy d = 0.39). Both studies reported sustained programme effects on sleep efficiency at follow-up. Paine and Gradisar's (2011) study generated large effect sizes at both one-month (sleep diary d = 0.91, actigraphy d = 1.85) and six-month follow-up (sleep diary d = 0.91). Schlarb et al's (2018) study generated medium to large effect sizes at twelve-month follow-up (sleep diary d = 0.65, actigraphy d = 0.96).

The CBT-based sleep interventions reviewed in this Chapter showed positive effects on reducing children's insomnia symptoms. After intervention, Paine and Gradisar (2011) reported small to large effect sizes of the intervention on reducing insomnia symptoms (d ranged from 0.31 to 3.31) (Paine & Gradisar, 2011). Byars and Simon (2014) also reported large effect sizes of the intervention on reducing study children's insomnia severity (d = 1.03 for early termination

group, d = 1.35 for the completed group). The positive effects reported in Paine and Gradisar's study were sustained at both one-month follow-up (d ranged from 0.26 to 3.06) and at six-month follow-up (d ranged from 0.12 to 2.85).

The CBT-based sleep interventions also showed positive effects on improving parent-reported child sleep disturbance and parent-reported child sleep-related behaviours. This was shown in Shlarb et al's (2018) study and Hiscock et al's (2015) study. Shlarb et al (2018) reported a medium effect size of the intervention in reducing children's sleep disturbance immediate after intervention (d = 0.55). The improvement was maintained at twleve-month follow-up (d = 0.63). Hiscock and colleagues' (Hiscock et al., 2015) study generated medium effect sizes in reducing parent-reported child sleep difficulties in initiating and maintaining sleep at follow-up (three-month d = 0.89; six-month d = 0.56). In terms of parent-reported sleep-related behaviours, Schlarb and colleagues' (2018) study generated medium effect size in improving child sleep-related behaviours immediate after intervention (d = 0.46) and at twleve-month follow-up (d = 0.70).

The CBT-based sleep intervention studies reviewed in this Chapter showed inconsistent effects in improving children's sleep duration. The intervention in Paine and Gradisar's (2011) study showed little effect in improving children's sleep duration (d ranged from 0.10 to 0.14 across three time-points). In contrast, the effect sizes calculated from Schlarb and colleagues' study (2018) generated medium effect sizes for the intervention in increasing children's total sleep time immediately after interveniton (actigraphy d = 0.51) and at twelve-month follow-up (actigraphy d = 0.46).

The sleep education programmes reviewed in this Chapter also showed inconsistent effects in improving children's sleep duration. Tamura and Tanaka's (2014) study generated overall medium to large effect sizes of the sleep education programme on improving one particular group of children's sleep duration (d from 0.42 to 0.95 for children in grade four). Mindell and colleagues (Mindell et al., 2016) reported a small effect size (d = 0.33). Although improvement in sleep duration was reported in another three studies (Maeda et al., 2019; Rey et al., 2020; Willgerodt et al., 2014), due to the lack of data, effect sizes were unable to be calculated. On the other hand, Gruber et al.'s (2016) study did not report improvement in sleep duration.

Ashton (2017) and Gruber et al. (2016) reported sleep efficiency. Effect sizes calculated from both studies revealed small effect sizes for intervention effects on increasing sleep efficiency. (Ashton: d = 0.38; Gruber et al.: d = 0.27).

Sleep education programmes reviewed in this Chapter presented some positive effects in improving children's sleep-related behaviours. Tamura and Tanaka's (2014) sleep education programme revealed small to medium effect sizes across all sleep-related behaviour measured in their study (2014) (d ranged from 0.07 to 0.6). Mindell and colleagues' (Mindell et al., 2016) study generated a large effect in reducing the number of electronics in children's bedroom (d = 1.10); and a small effect in reducing children's caffeinated beverage daily intake (d = 0.31). Willgerodt and colleagues (Willgerodt et al., 2014) reported some improved sleep behaviours, however, effect size calculation was not available due to the nature of qualitative study.

Variables related to the impact of sleep. School grades were measured in two studies (Ashton, 2017; Gruber et al., 2016). Gruber et al's (2016) study generated small effect sizes across school grades in Physical education (d = 0.48), Mathematics (d =0.2), and English (d =

0.22). Ashton (2017) collected mean scores on reading, writing and mathematics at baseline, yet no measure nor analysis was performed post-intervention.

Tamura and Tanaka (2014) measured daytime functioning. The results showed that their school-based sleep intervention had some effect on items measuring school daytime functioning, in particular, the programme had positive impact on reducing children's daytime irritability (d = 0.38) and reducing children's daily inattention (d = 0.44).

Three studies measured daytime sleepiness (Paine & Gradisar, 2011; Schlarb et al., 2018; Tamura & Tanaka, 2014). An immediate post-intervention effect on improved daytime sleepiness was found in all three studies. Paine and Gradisar (2011) reported a medium effect size (d = 0.49), whereas small effect sizes were revelaed in Tamura and Tanaka's (2014) study (d = 0.23) and Schlarb and colleague's (2018) study (d = 0.16). The positive impact was maintained during follow-up in two studies and both studies revelaed large effect sizes at follow-up (d = 0.88 in Paine & Gradisar, 2011; d = 0.70 in Schlarb et al., 2018).

Paine and Gradisar (2011) measured mental health in their study. They found that the CBT-based sleep intervention had small to large effects across items in both children's self-report and parent-report measuring mental health (d ranged from 0.12 to 1.01).

Behavioural and emotional problems were measured in two studies. In the study of Hiscock and colleagues (Hiscock et al., 2015), the intervention had a positive effect in reducing study children's ADHD symptoms at both three-month follow-up (d = 0.59) and at six-month follow-up (d = 0.71). Medium to large effects were found on improving children's quality of life at three-month follow-up (d = 0.86) and at six-month follow-up (d = 0.67). Willgerodt and colleagues (Willgerodt et al., 2014) reported improvement in children's behaviours as reported by parents. Calculation of effect size was not available due to the nature of the qualitative study.

Two studies included measurements of areas of executive functioning. Hiscock and colleagues (Hiscock et al., 2015) measured working memory. However, the comparison was made between groups, and no original baseline and post-intervention data were reported in the study. Hence effect size was unable to be calculated. Rey and colleagues (Rey et al., 2020) reported improved domains of executive functioning. However, the standard deviations given in the original study had been adjusted, which affected effect size calculation.

Summary

The current literature review investigated sleep interventions conducted on school-aged children, which filled the current literature gap. It also expanded sample participants to involve children with ADHD (Hiscock et al., 2015), children with mild learning disability and children with asthma (Willgerodt et al., 2014).

Firstly, the literature review showed that sleep intervention studies often included the measurements of various variables. Of the eleven studies reviewed in this Chapter, only sleep duration (time in bed, total sleep time) was commonly measured in most studies (eight studies). Other sleep variables found in the studies reviewed in this Chapter included: sleep efficiency, sleep onset latency, sleep difficulties/sleep disturbance, sleep-related behaviour and etc. Sleep-related variables (secondary outcome variables) included in the studies reviewed in this Chapter also differed. These could include school grades, areas of executive functioning, school daytime functioning, daytime sleepiness, behavioural and emotional problems, etc.

Secondly, studies often reported mixed results on sleep variables. For example, of the eight studies which measured sleep duration in the current literature review, six studies reported improvement in sleep duration following sleep intervention, while the other two reported no improvement. These results were consistent with findings in Blunden et al's (2012) and Busch et

al's (2017) meta-analyses, where studies included in both meta-analyses reported inconsistent results on sleep duration.

Thirdly, the current literature review indicated that the effect of sleep interventions on changing sleep-related behaviours needed to be further studied. While the few CBT-based sleep interventions reviewed in this Chapter generated overall small to medium effect sizes in changing sleep-related behaviours, studies examining the effect of sleep education programmes on sleep-related behaviours reported less-effective results. This was consistent with findings reported in Blunden et al's (2012) and Busch et al's (2017) meta-analyses.

Finally, the one study which measured areas of executive functioning in the current literature review showed promising results (Rey et al., 2020). It provided evidence that sleep education programme could have a positive impact on improving children's cognition in addition to improving sleep-related variables.

None of the studies reviewed in this Chapter involved children from a post-disaster community. As suggested by Blunden et al's (2012) and Busch et al's (2017) meta-analyses, successful sleep intervention should study the target population's bioecological factors. Therefore, a sleep intervention that may well address children's sleep condition in a post-disaster community is desired.

Rationale and the Research Question for the Current Study

A recent study has shown that 70% of primary school children in the eastern suburbs of Christchurch were experiencing sleep problems following earthquakes (Liberty et al., 2016). Sleep problems, including short sleep duration, bedtime behaviour problems, may interfere with the children's daily mood and functioning, including working memory and facial emotion

recognition, as previously discussed in Chapter One. Schools in the eastern side of Christchurch were delivering the *Yes I Can! Sleep Education Programme* (Liberty, 2018), a sleep education programme that was specifically created for children here in Christchurch. This has provided an opportunity for a pilot single-subject study to evaluate the effects of the YIC programme.

The current study aimed to investigate the effects of a self-help sleep intervention programme *Yes, I Can! Sleep Education Programme* (Liberty, 2018) among school-aged children in a post-earthquake community. Did the YIC programme improve study children's sleep? Did the programme have any effects in enhancing children's working memory? Did the programme have any impact on improving children's emotion recognition?

Chapter Three: Methods

Ten children between the age of eight to twelve years from a primary school in Christchurch, New Zealand, participated in a single-subject study to evaluate the effects of an eight-week sleep education programme delivered by teachers. Children kept their own sleep diary and recorded their sleep behaviours over three weeks: seven consecutive days of baseline, seven consecutive days after the programme, and seven consecutive days follow-up, approximately three months after the programme. Children also completed the Sleep Self-Report and cognitive tests once per phase.

Design

An A-B_1-B_2 single-subject design replicated across children was employed. The study phases were baseline phase (A), post-intervention phase, immediately after sleep education (B_1), and a follow-up phase (B_2).

Single-subject design featured repeated measures of single subjects' target variables by employing each child as his/her control (Cooper, Heron, & Heward, 2007). Compared with between-groups experimental design, where changes in a group's overall performance did not necessarily reveal changes in each child, the single-subject design allowed interpretation and evaluation of individual change patterns (Cooper et al., 2007).

Ethical Approval and Professional Preparation

Ethical approval for this study was obtained from the University of Canterbury Educational Research Human Ethics Committee (Ref: 2018/12/ERHEC see Appendix A) on 4 April 2018. The study researcher completed a police check, provided two reference checks and

completed a prescribed interview to meet the requirements stipulated in the Vulnerable Children Act 2014 (Vulnerable Children Act 2014, s. 31) prior to the commencement of recruitment.

The study researcher prepared a study information package that contained a letter with an information sheet to the school principal detailing the study (see Appendix B) and a consent form (see Appendix C) to participating in the study. A similar package was provided to the teacher, which comprised a letter with an information sheet (see Appendix D) and a consent form (see Appendix E). A take-home information package was provided for the child and parents/caregivers interested in participating in the study, containing letter and information sheets to parents/caregiver and child (see Appendix F), parent/caregiver consent form (see Appendix G) and child consent form (see Appendix H).

Recruitment

Children were recruited from the pupils who would receive the *Yes, I Can! Sleep Education Programme* (Liberty, 2018) at School A during school term two. At School A, teachers who taught children between the ages of eight to twelve years nominated those who were having sleep problems to the teachers' knowledge (for example, children who always appeared sleepy in class; parents' comments on children having trouble sleeping, etc). The Principal and the Deputy Principal contacted these children's parents by phone. Among them, those interested in participating in the study were given the child and parents' information package. The Deputy Principal collected the signed consent forms from the children and the parents. The study researcher was contacted by the Deputy Principal to pick up the signed consent forms from the Principal, the teachers, and the child and parents from the school.

BEARS Questionnaire

The Bedtime issues, Excessive daytime sleepiness, night Awakenings, Regularity and duration of sleep, and Snoring (BEARS) questionnaire developed by Owens and Dalzell (2005) was used in the current study to screen for the presence of sleep problems in prospective children. As indicated by the name of the questionnaire, the acronym represents five sleep domains: “Bedtime problems”, “Excessive daytime sleepiness”, “Awakenings during the night”, “Regularity and duration of sleep”, and “Sleep-disordered Breathing”. For school-aged children (six to twelve years), the BEARS questionnaire contains eight questions in total, two for each sleep domain. The child answered one question each for the “Bedtime problems”, “Excessive daytime sleepiness”, and “Awakening during the night” sleep domains. The parents also answered one question for each sleep domain (Owens & Dalzell, 2005).

The questionnaire was initially developed and assessed as suitable for obtaining information on sleep-related behaviour and identifying sleep problems for children in the primary care setting between the ages of two to twelve years (Owens & Dalzell, 2005). It has been used widely in otherwise healthy children (Velten-Schurian, Hautzinger, Poets, & Schlarb, 2010). The questionnaire had also been assessed as suitable to use with children with ADHD (Cortese et al., 2013) and children with neurodevelopmental disabilities (Jan et al., 2008).

An additional question that asked children whether they had bad dreams was included with the BEARS questionnaire in the current study. Having bad dreams is a symptom of Post-Traumatic Stress Disorder (American Psychiatric Association, 2013). It was often reported by children who experienced earthquakes. A study conducted in Taiwan found that among the 607 male elementary students and 562 female elementary students who experienced the 1999 Taiwan Chi-Chi earthquake, 23.2% of the boys and 19.7% of the girls reported having recurrent

distressing dreams one year later (Chen et al., 2002). Similarly, a Turkish study found 22.2% of the children aged zero to six (N = 9) and 68.8% of the children aged seven to eleven (N = 16) reported nightmares/bad dreams following the earthquakes in August and November 1999 (Yorbik et al., 2004). In New Zealand, Liberty and colleagues (Liberty, Allan, Bangma, McNaughton, & Liberty, 2019) reported that among the 306 children who experienced Canterbury earthquakes from 4th Sept 2010 till the entry of primary school and onwards, 44% reported having bad dreams.

Eight BEARS's questions and the additional child-directed bad dream question were integrated into child and parents' consent forms (see Appendix G and Appendix H for details). A "yes" response to any question indicated possible sleep problems. The study researcher counted the total number of "yes" responses in each BEARS domain and the additional bad dream question for child screening.

Inclusion and Exclusion Criteria

The following comprised the inclusion criteria: (1) Children had at least one parent-reported or self-reported sleep problem identified by the BEARS questionnaire. (2) Children who were living in Christchurch during the extensive period of earthquakes from September 2010 to December 2013. Those receiving ongoing support from the Ministry of Education due to their diagnosed high or very high special needs were to be excluded from the study, as their intervention programme might have confounded results of the present study.

All children nominated by their teachers and whose parents consented, met the inclusion criteria. No children were excluded from participating in this study.

Setting

School A was a state primary school of 342 children in grades 1 - 8 (54% boys and 46% girls) located in the southeast of Christchurch, New Zealand, with fourteen classrooms (Education Review Office, 2017). The southeast part of the city was one of the areas hardest hit by the earthquake sequences. School deciles measure the socio-economic position of a school's student community compared to other schools throughout the country. Scores range from one to ten, with a lower score indicating a higher proportion of students from low socio-economic communities and a higher score representing fewer of these students (Ministry of Education, n.d.). School A was a decile four school.

Eight teachers delivered the *Yes, I Can! Sleep Education Programme* (Liberty, 2018) across grade years three to eight during the second school term. A spare room at the school was used by the study researcher as needed to administer study assessments. The schedule during the school day for each assessment was determined through discussion with the teacher. Assent was obtained from the child to leave class before each assessment, according to approved ethical procedures. Nine out of the ten children took the assessments at school.

Participants

Study children attended School A and resided in the southeast suburbs of the Christchurch city centre. Study children ranged from eight to twelve years of age.

Amy. Amy was eight years old in grade year three. Her teacher was the same as Albert's. Amy's BEARS report stated that she had sleep problems in the following sleep domains: "Bedtime problems", "Excessive daytime sleepiness", "Awakenings during the night", and "Sleep-disordered Breathing". Amy also reported sometimes having bad dreams.

Alex. Alex was eight years old in grade year four. He was the only child in his class who participated in this study. Alex's BEARS report stated that he had sleep problems in the following sleep domains: "Bedtime problems", "Excessive daytime sleepiness", "Awakenings during the night", and "Regularity and duration of sleep". He did not report bad dreams.

Albert. Albert was eight years old in grade year four. His teacher was the same as Amy's. Albert's BEARS report stated that he had sleep problems in the following sleep domains: "Bedtime problems", "Excessive daytime sleepiness", "Awakenings during the night", and "Regularity and duration of sleep". He also reported sometimes having bad dreams.

Edward. Edward was ten years old in grade year five. Edward was the only child participating in the study from his class. Edward's BEARS report stated that he had sleep problems in all five sleep domains. Edward also reported sometimes having bad dreams.

Ethan. Ethan was ten years old in grade year five. He was the only child from his class that participated in the study. His BEARS report stated that he had troubles with sleep problems in the following sleep domains: "Bedtime problems", "Excessive daytime sleepiness", "Awakenings during the night", and "Regularity and duration of sleep". He did not report bad dreams.

Max. Max was eleven years old in grade year seven. His teacher was the same as Mia's and Eva's. Max's BEARS report stated that he had sleep problems in the following sleep domains: "Bedtime problems", "Excessive daytime sleepiness", "Awakenings during the night", and "Regularity and duration of sleep". He did not report bad dreams.

Emma. Emma was eleven years old in grade year seven. Her teacher was the same as Edith's. Emma's BEARS report stated that she had sleep problems in the following sleep

domains: “Bedtime problems”, “Excessive daytime sleepiness”, “Awakenings during the night”, and “Regularity and duration of sleep”. She also reported often having bad dreams.

Mia. Mia was eleven and a half in grade year seven. Her teacher was the same as Max’s and Eva’s. Mia’s BEARS report stated that she had sleep problems in the following sleep domains: “Bedtime problems”, “Excessive daytime sleepiness”, “Awakenings during the night”, and “Regularity and duration of sleep”. She also reported sometimes having bad dreams. She had been taking melatonin on school nights, and this continued throughout the study.

Eva. Eva was twelve years old in grade year eight. Her teacher was the same as Max’s and Mia’s. Eva’s BEARS report indicated that she had sleep problems in the following sleep domains: “Bedtime problems” and “Awakenings during the night”. She also reported having bad dreams.

Edith. Edith was twelve years old in grade year eight. Her teacher was the same as Emma’s. Edith’s BEARS report indicated that she had sleep problems in the following sleep domains “Bedtime problems”, “Excessive daytime sleepiness”, “Awakenings during the night”, and “Regularity and duration of sleep”. She reported sometimes having bad dreams. According to Edith’s mother, Edith napped after school on the days she felt tired.

Intervention: *Yes I Can! Sleep Education Programme*[1]

The *Yes, I Can! Sleep Education Programme* (Liberty, 2018) was a manualized programme for children between the ages of nine to twelve. It was designed to be delivered by teachers. The programme aimed to improve children's knowledge of sleep and sleep behaviours (covered in Workbook 1), and then for the children to apply this knowledge to change their own sleep (covered in Workbook 2) (Liberty, 2018). The theoretical underpinning of the programme was self-determined learning theory (Ryan & Deci, 2000). The programme consisted of five parts, including a manual for teachers, two workbooks for children, an open-access website, and a Facebook page for parents.

The *Teacher's Resource Book* provided information and support for teachers on the programme content, as well as a set of directions for each lesson/content area.

The *Sleep Inquiry Book (*Workbook 1*)* for the children contained instructional topics and tasks for children to complete with teacher guidance in order to improve their knowledge about sleep. Topics included sleep facts, animal facts of sleep, dreaming, sleep-wake cycle, sleep hygiene, sleep senses, sleep around the world, recommended hours of sleep, how sleep changes behaviour and the impacts that sleep have on the body.

The *I Am A Sleep Scientist Book (*Workbook 2*)* provided a guide for the children to study their own sleep patterns, a sleep diary, and set out steps for children to set goals to improve sleep behaviours. Using self-determined learning processes (Ryan & Deci, 2000), children collected sleep data, set sleep goals, engaged in problem-solving, collected more sleep data, and then

[1] The Intervention (Dependent Variable) is described before the instruments and measures so that the readers would have a clearer view of the overall flow of the study.

reflected on the data and revised sleep goals as needed (Liberty, 2018). Portable digital clocks were provided to assist children in recording bedtimes and awake times in their sleep diaries.

The accompanying website "bromtreeinquiry" (https://bromtreeinquiry.wordpress.com) had been set up by the author of the *Yes, I Can! Sleep Education Programme* (Liberty, 2018) as an interactive platform that also provided additional sleep study resources. Teachers and children could submit their work for display or ask questions about sleep and receive answers from the author.

The Facebook parent page facilitated as a parent support network. A clinical child psychologist supported both the webpage and the parent group. The overall programme was independently reviewed prior to its use by one of my senior supervisors, a sleep researcher, Associate Professor Karyn France.

School A teachers who implemented the *Yes, I Can! Sleep Education Programme* (YIC programme) received the four-hours of training from the author of the programme on one day in the last week of term one before the teaching programme commenced. From the first or second week of term two, teachers started to deliver the YIC programme (Liberty, 2018) during regular school hours. The programme was taught two to four times each week for five to nine weeks. Each session lasted approximately 50 minutes.

Instrumentation

Sleep diary. The children reported on their sleep using sleep diaries (see Appendix I). Sleep diaries were a well-accepted and established measurement of sleep in adults and children (Carney et al., 2012). Among studies conducted on children between the ages of five to thirteen, high correlations were found in sleep parameters measured by sleep diary and actigraphy, suggesting children were competent in recording sleep (Paine & Gradisar, 2011; Schlarb et al., 2018). The current study used the "sleep slip" designed in the YIC programme (Liberty, 2018) as the study sleep diary. Each sleep diary contained seven sheets of the sleep slip for the use of seven conservative nights at phase A, phase B_1 and phase B_2. On each sleep slip, children were asked about their bedtime, wake time, time in bed, how easily they fell asleep, how they felt when they woke up and how they felt during the day. Each child was given a sleep folder (see Appendix J) that included instructions on completing the sleep slip, eight sheets of sleep slip (sleep diary for one measurement period), a sample sleep slip complicated by the study researcher as an example, and a small portable clock.

Sleep Self-Report (SSR). The current study used the Sleep Self-Report (SSR) questionnaire (Owens, Maxim, Nobile, McGuinn, & Msall, 2000) to reflect children's sleep behaviours (see Appendix K). There were three subscales: Bedtime, Sleep Behaviour and Daytime Sleepiness. The Bedtime subscale covered items four to fifteen that build around children's sleep attitude and sleep behaviour at bedtime. The Sleep Behaviour subscale included item sixteen to 22 that focused on sleep behaviour during the night. The Daytime Sleepiness subscale contained items 23 to 26; children were asked about their behaviour during the day. The instrument's internal consistency was reported as acceptable ($a = 0.71$) (Lewandowski, Toliver-Sokol, & Palermo, 2011). The questionnaire had been used and assessed as suitable for

pre-schoolers (Gregory, Willis, Wiggs, Harvey, & the STEPS team., 2008), school-aged children (Gregory et al., 2008; Willgerodt et al., 2014) and adolescents (Pirinen, Kolho, Simola, Ashorn, & Aronen, 2010).

The SSR contained three general questions and 23 questions. All items were answered on a 3-point Likert scale: "Usually" (5 to 7 times per week), "Sometimes" (2 to 4 times per week), and "Rarely" (0 to 1 time per week or never). The items were scored as "Usually" (3 points), "Sometimes" (2 points) and "Rarely" (1 point). For the current study, items were adjusted to reflect the New Zealand cultural context. Six out of the 26 items were omitted. Items 5, 6, 7, 14 and 22 related to co-sleeping were omitted because co-sleeping is a common cultural practice in NZ (Blair, 2008; George et al., 2020; Scragg et al.,1993; Tuohy, Smale, & Clements, 1998). Item 21 was omitted because it addressed physical pain. Co-sleeping and physical pain were not addressed by the design of the YIC programme. As a result, there were 17 items administered in the current study, giving a total score of SSR that ranged from 17 to 51.

Cognitive performance instruments. The Cambridge Neuropsychological Test Automated Battery Standard 2.0 (CANTAB) (https://www.cambridgecognition.com/cantab) measured domains of cognition. Two sub-tests of the CANTAB were used to assess the performance of cognition related to sleep in this study: the Spatial Working Memory task (SWM) and the Emotion Recognition Task (ERT). The sub-tests were presented on an iPad from Apple Inc., using software from Cambridge Cognition.

The SWM test assessed cognitive strategy and working memory. As previously discussed in Chapter One, research indicated that children's working memory was closely related to sleep. Reduced sleep duration or inadequate sleep quality were associated with poorer

performance on working memory tasks (Kopasz et al., 2010; Könen et al., 2015; McCann et al., 2018; Steenari et al., 2003).

The SWM test was considered suitable for children to use. It had been administered in studies conducted with children with Attention-Deficit Hyperactivity Disorder (ADHD) (Gomez, Gomez, Winther, & Vance, 2014), children with Autistic Spectrum Disorders (Yerys et al., 2019), typically developing children (Sheppard & Cheatham, 2013), adolescents and young adults (McKewen et al., 2019).

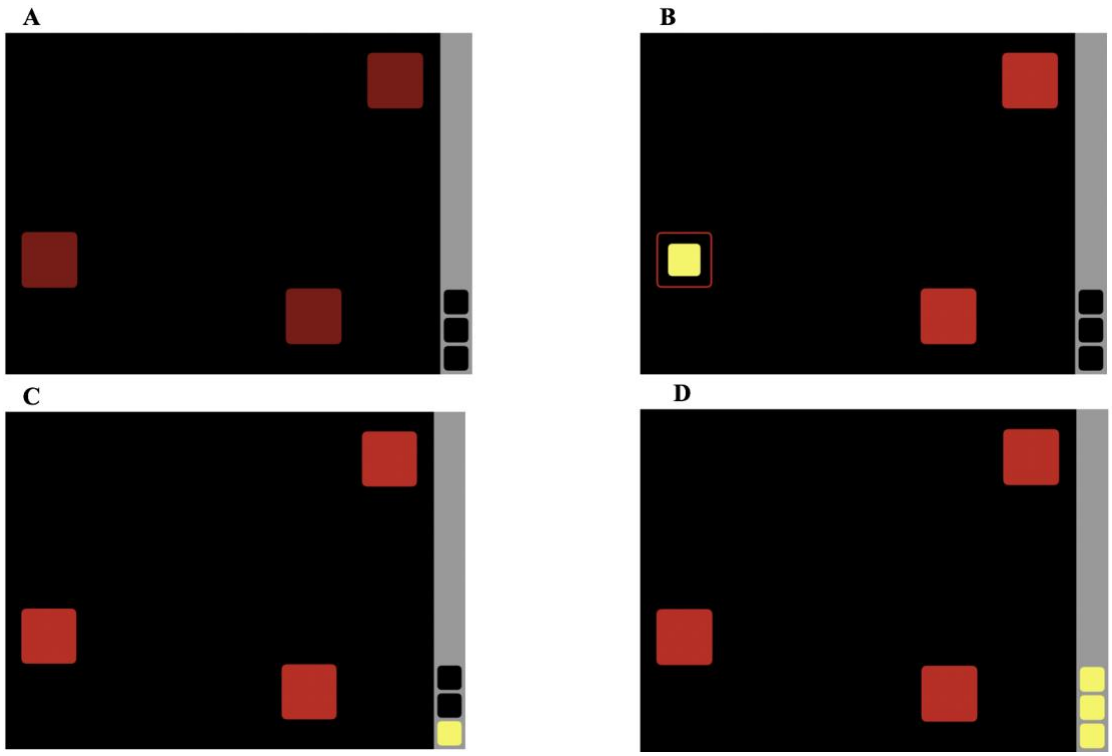

Figure 1. Procedure for the Cambridge Neuropsychological Test Automated Battery (CANTAB) Spatial Working Memory (SWM) test.

The task asked children to find three tokens hidden underneath one of several boxes. A female voice gave instructions and guided the child to carry out the task step by step. Each child first received two practice trials. During the practice, the child was presented with three

coloured boxes (see Figure 1.A). The child was asked to look for a token by touching one of the boxes (see Figure 1.B). Once a token was found, the child was required to touch the outline on the right side of the iPad screen to collect the token (see Figure 1.C). The child continued to search for another token until all three tokens were collected (see Figure 1.D). This was repeated for a second practice trial. After completing both practice trials, the child progressed to the next level, where the number of coloured boxes increased to four, followed by six coloured boxes, and finally to eight boxes. There was one trial for each level. The test took about four minutes to complete.

Results were generated by the CANTAB software and, two scores were used in the present study: Strategy Score and Total Error Score. The strategy score represented planned searching strategy use for finding the token. A good strategy score indicated the child used a consistent search strategy by always starting the search for the token from the same box. Strategy Scores ranged from two to fourteen, with a lower score indicating a better and more consistent search strategy. The total error score was the total number of times the child returned to a previously visited box that had already been determined not to have a token. Scores ranged from zero to 157, with a lower score indicating fewer errors and more accurate performance.

The second CANTAB test selected was the Emotion Recognition Task (ERT). ERT assessed the rapidity and accuracy of identifying facial expressions with six basic human emotions: sadness, happiness, fear, anger, disgust and surprise (“Emotion Recognition Task”, n.d.).

The ability to accurately and quickly identify facial expressions from emotions is related to sleep. As previously discussed in Chapter One, the association between sleep deprivation and poor accuracy on facial recognition has been reported in adults and children (Killgore et al.,

2017; Soffer-Dudek et al., 2011). ERT had been used to assess adolescents and adults (Glenthøj et al., 2018; Russo et al., 2015), and school age children (ie. Thorup et al., 2015).

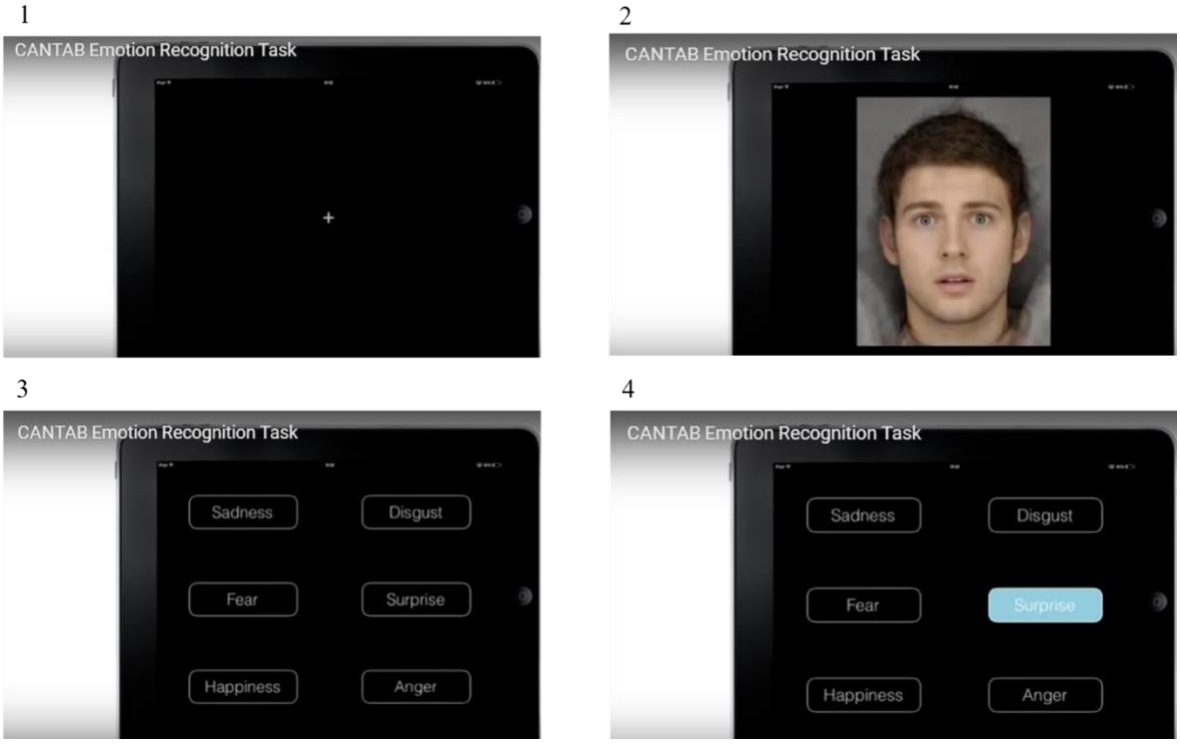

Figure 2. Procedure for the Cambridge Neuropsychological Test Automated Battery (CANTAB) Emotion Recognition Task (ERT) test.

The task required children to correctly identify emotions from facial expressions as many as possible and as fast as possible. A female voice gave instructions and guided the child to carry on the test step by step during the practice. For practice, the child was asked to look at the white cross on the screen so that the child was ready to see the face that would be showing immediately afterwards (see Figure 2.1). A photo image of an adult face displaying a particular emotion appeared on the screen for 200 milliseconds (see Figure 2.2), followed by six boxes describing different emotions (see Figure 2.3). The child was directed to touch the box that he/she thinks best describes the emotion (see Figure 2.4). When an emotion word was chosen by the child touching the screen, the white cross appeared back on the screen before the next facial

expression came out. The child took five practice trials before moving on to the assessment. There were no verbal instructions during the assessment. The test had a memory element designed in it, as children needed to recall the facial expression previously displayed on the screen when they chose an emotion word to match the facial expression.

Results were generated by the CANTAB software. The ERT scores for the accuracy of emotion recognition for each emotion were based on eight trials per emotion. These were combined for the overall score. Higher scores indicated better accuracy of emotion recognition. The overall median reaction time was also used in the present study. A shorter overall median reaction time indicated a faster response.

Repeated Measures

Time in bed. Time in bed was calculated from the time the child recorded bedtime to the time the child woke up the next morning as recorded in the sleep diary. Children recorded times they went to bed and got out of bed for seven consecutive nights in a school term during phases AB_1B_2 using the sleep diaries provided by the study researcher. Time in bed on school nights and time in bed on non-school nights were distinguished and analysed separately.

Feeling on awakening. The child ticked a box on the sleep slip in the sleep diary as to how he/she felt when waking up in the morning by choosing from “Refreshed”, “Drowsy”, and “Exhausted”. Feeling on awakening was recorded for seven consecutive days during a school term during phases AB_1B_2 using the sleep diaries.

Feeling during the day. The child ticked a box on the sleep slip in the sleep diary as to how he/she felt during the day from "Amazing", "Good", "OK", "Moody", and "Grumpy" before they went to bed each night. Feeling during the day was recorded for seven consecutive days during a school term during phases AB_1B_2 using the sleep diaries.

Other Independent Variables

Sleep variables. In addition to the repeated measures, the SSR was administered once per phase. The variables measured from the SSR were: overall sleep problems (the SSR total score); sleep problems at bedtime (the SSR bedtime subscale score); sleep behaviour problems (the SSR sleep behaviour subscale score); and daytime sleepiness problems (the SSR daytime sleepiness subscale total score).

Cognitive variables. In addition to the repeated measures, the CANTAB sub-tests were administered once per phase. Variables measured from the CANTAB Spatial Working Memory (SWM) subtest were: Working memory accuracy from the total error score; Working memory strategy, from the strategy score. Variables measured from the CANTAB Emotion Recognition Task (ERT) subtest were: Emotion recognition accuracy from the overall emotion recognition score; and Emotion recognition speed from the overall median reaction time.

Intervention engagement. The study researcher assessed the child's engagement in the sleep education programme during the programme's implementation period and upon completing the programme. During the implementation period, the study researcher contacted children's parents about a scheduled visit to School A, aiming to take some pictures of the children' *Sleep Inquiry Book* (Liberty, 2018) and the *I Am A Sleep Scientist Book*. The children gave assent via text messages or phone calls through the parents. The Deputy Principal of School A arranged the workbooks from the children for the study researcher to review. The study researcher visited

School A and took pictures of the children's *Sleep Inquiry Book* (Liberty, 2018) and the *I Am A Sleep Scientist Book* (Liberty, 2018). Upon completing the programme, the study researcher contacted the children's parents, notified the children about the post-programme measurement date, and asked them to bring both workbooks. In addition to taking more pictures of both workbooks, the study researcher asked questions on sleep goal setting, goal achievement and goal maintenance. The level of engagement was categorised as "no engagement" when no written work was observed in both workbooks, and no other source confirmed programme engagement (e.g., detailed verbal descriptions from the child or emails from the teacher); "some engagement" when some work was observed in at least one of the workbooks; and "full engagement" when work was completed in both workbooks. Goal setting and achievement of the goal were also important variables of programme engagement. Goal setting and achievement of the goal were categorized as "no goal", "goal set not achieved", and "goal set and achieved". The achievement (or not) of the goal was determined by the child (it was a written component of Workbook 2).

Intervention implementation. After the intervention, the study researcher delivered a blank qualitative teacher's feedback sheet (see Appendix L) to all teachers whose students participated in the current study. Teachers were asked to identify the school week they started and finished the YIC programme, how often the YIC programme was taught, how long each session lasted, how many weeks in total the programme was taught. Teachers were welcomed to provide any feedback/ comments on the YIC programme.

Procedures

Baseline (Phase A). Phase A was scheduled during the first week of school term two, 2018, a week prior to the start of the sleep education programme. The study researcher visited each child at his/her home with a parent's present. During the visit, the study researcher explained the sleep diaries, the SSR questionnaire and the cognitive tasks. A pack of sleep diaries that consisted of a colouring cover page, a plastic pocket, eight sheets of sleep slips, and a laminated instruction page on completing the sleep slips were given to each child at the end of the meeting. All children were instructed to start on the sleep diaries on the first night of term two.

On Friday of the first week of term two, the study researcher visited School A to administer the cognitive tests and the SSR questionnaire. The school provided a spare room. A timetable with each child's assessment time was organised and provided by the Deputy Principal in advance. Teachers of the children were aware of the assessment time. Upon arrival to the spare room, the child was asked to give an assent to complete the assessment tasks. The study researcher started on the measures when assent was given. Each assessment task was explained to the child with a demonstration, and the child was allowed to practice the tasks before the assessments. The child completed the SWM task (approximately four minutes) and ERT task (approximately six minutes) on an iPad provided by the study researcher, as described. The SSR questionnaire (approximately ten minutes) was completed by the child independently or with the study researcher's help when requested. At the end of the assessment session, the study researcher reminded each child to complete the sleep diaries and answered questions related to completing the sleep diaries. The study researcher contacted each child's parents and picked up the sleep diaries a week later.

Post-intervention phase (Phase B_1). Phase B_1 was scheduled during the last week of school term two, immediately after the sleep education programme was scheduled to be completed in School A. The study researcher visited the children and their parents the weekend before to deliver sleep diaries and answered questions related to the study. The children were requested to start on the sleep diaries from Sunday night.

On the Monday of the last week of term two, the study researcher visited School A to administer the cognitive tasks and the SSR questionnaire based on the same timetable used at phase A. Each child completed the same assessments as in phase A.

Each child showed the study researcher his/her *Sleep Inquiry Book* and *I Am A Sleep Scientist* Book. The study researcher asked each child whether he/she set a sleep goal. What the sleep goal was. Did he/she achieve the sleep goal? If the goal was achieved, was he/she still practising the good sleep behaviour related to the goal? Did he/she wish to share anything about his/her recent sleep? At the end of the assessment session, the study researcher reminded each child to complete the sleep slips in the sleep diary and answered questions related to completing the sleep diary. The study researcher picked up the sleep diaries from the children's home during the term breaks when called by the parents.

Follow-up (Phase B_2). Phase B_2 was scheduled during the last week of school term three, eleven weeks following the sleep education programme's completion. Similar to phase B_1, the study researcher visited the children and their parents the weekend before to deliver sleep diaries and reminded the children to start on the sleep diaries from Sunday night.

On the Monday of the last week of term three, the study researcher visited School A to administer the cognitive tasks and the SSR questionnaire based on the same timetable used at phase A and phase B_1. Each child took the same assessments as the previous two phases. The

study researcher asked each child whether he/she continued practising the sleep goal, which was achieved earlier? Did he/she wish to share anything about his/her recent sleep? At the end of the assessment session, the study researcher reminded each child to complete the sleep slips in the sleep diary and answered questions related to completing the sleep diary. The study researcher contacted the children' parents and picked up the sleep diaries when they were completed.

Data Analysis

Data from the sleep diaries were transferred into Microsoft Excel spreadsheets, and single-subject graphs were generated for the repeated measures of Time in Bed for each child. Changes were determined using visual analysis. In addition, split-middle trend analysis was conducted to study changes across three phases (Cooper et al., 2007). Repeated measure graphs for "Feeling on awakening" and "Feeling during the day" were constructed across three phases for each child. For the non-repeated measures, bar graphs were prepared to visually display changes in sleep problem scores and cognitive tests at the three measurement time points.

Chapter Four: Results

Results are presented first for individual children. To aid interpretation of the data, these results are organised around the level of exposure the children had to the independent variable because this varied across the group. There were two levels of exposure, three children (Amy, Alex and Albert) who partially engaged in the YIC programme (Liberty, 2018), and then the other seven children fully engaged in the YIC programme (Edward, Ethan, Emma, Eva, Edith, Max, and Mia). The minimum level of engagement required to be included in the study was for children to attend classes in the Sleep Inquiry learning period. The partially engaged children may have attended classes and produced written work in the *Sleep Inquiry Books* (liberty, 2018), but may have neglected to set their own goals or missed components of the programme, such as recording their own sleep using the sleep slips during the Sleep Scientist learning period. The fully engaged children may have attended classes during both the Sleep Inquiry learning period and the I Am A Sleep Scientist learning period and produced written work in both workbooks. They may have also set sleep goals, but some may not achieve the sleep goals. All of the children, except Edith, spent the recommended time in bed for their age during the study. This section is followed by a summary of effects across children. The studies discussed in Chapter Two, Literature Review, used quantitative analysis; so, for purposes of comparison, following visual analysis of the repeated measures, means and standard deviations for each phase are included.

Children - Some Engagement

Amy. Amy showed some engagement in the *Yes I Can! Sleep Education Programme* (Liberty, 2018) by completing the *Sleep Inquiry Book* (Liberty, 2018). No written work was

observed from the *I Am A Sleep Scientist Book* (Liberty, 2018) because she had been overseas during most of the teaching period; consequently, Amy did not set a sleep goal.

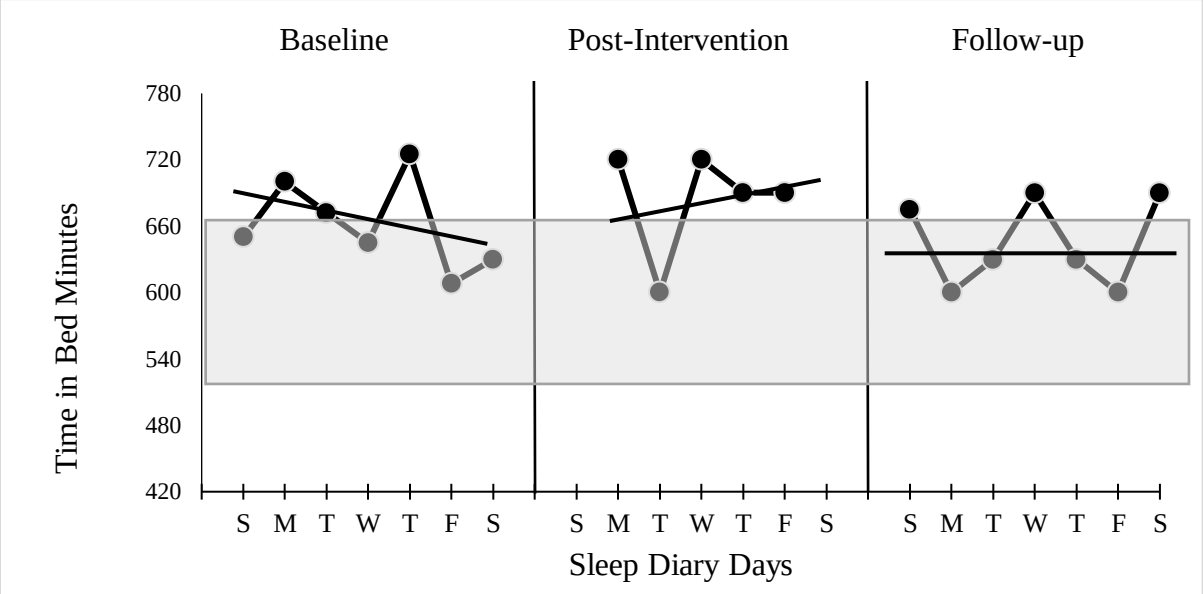

Figure 3. Repeated measures of time in bed in minutes from Amy's self-report sleep diary for each phase, and split-middle trend lines (Cooper et al., 2007).

Note: The shaded area shows the recommended time in bed of 9 to 11 hours for school-aged children between 6 – 13 years (Hirshkowitz et al., 2015).

Repeated Measures.

Time in bed. Amy's time in bed during phase A, B_1 and B_2 is presented in Figure 3. There was an improvement in Amy's time in bed from phrase A to phase B_1 and this was stable through phase B_2. Comparing Amy's time in bed with that recommended for the age group, she spent the recommended time or longer in bed on every night across all phases.

Trend analysis indicates that her time in bed decreased during phase A. She spent the least amount of time in bed on Friday night, and the most amount of time in bed on Thursday night. Amy's time in bed increased following the YIC intervention during phase B_1, as shown by trend analysis. Amy spent the least amount of time in bed on Tuesday night due to a parent

and teacher interview that ran late. She spent the most amount of time in bed on Monday and Wednesday nights. Compared with baseline, Amy spent more time in bed on Monday, Wednesday and Friday after sleep education. Trend analysis indicates that Amy's time in bed remained stable during phase B_2. She spent the least amount of time in bed on Monday and Friday nights, and the most amount of time in bed on Wednesday and Saturday nights.

Amy's means and standard deviations of time in bed at phases A, B_1 and B_2 are compared. During the baseline phase A, Amy's average time in bed was 661.43 minutes (SD = 40.59). She spent more time in bed on school nights than on non-school nights (Mean = 678.40 minutes, SD = 33.92, vs. Mean = 619 minutes, SD = 15.56). During the post-intervention phase B_1, where data were not available for Saturday and Sunday nights, Amy's average time in bed was 684 minutes (SD = 49.26), 22.57 minutes more than her average time in bed during the baseline phase A. Compared with baseline, Amy spent about four minutes more in bed (Mean = 682.5, SD = 56.79, vs. Mean = 678.40, SD = 33.92) on school nights after sleep education. On non-school nights, where data were not available on Saturday night, Amy's time in bed on Friday was 690 minutes, which was 82 minutes more than the Friday night of baseline. During the follow-up phase B_2, Amy's time in bed on Saturday night was adjusted by taking an hour away due to the start of day-light savings in New Zealand. The mean time in bed during phase B_2 was 645 minutes (SD = 39.69), which was 39 minutes less than the mean time in bed of the previous phase. Amy's average time in bed on school nights and non-school nights were about the same (Mean = 645 minutes, SD = 36.74, vs. 645 minutes, SD = 63.64) during this phase. Compared with the previous phase, Amy spent 37.5 minutes less on average per school night (Mean = 645 minutes, SD = 36.74, vs. Mean = 682.5, SD = 56.79), and 45 minutes less per non-

school night (645 minutes, SD = 63.64, vs. 690, SD = 0). However, all times were within the recommended range for her age.

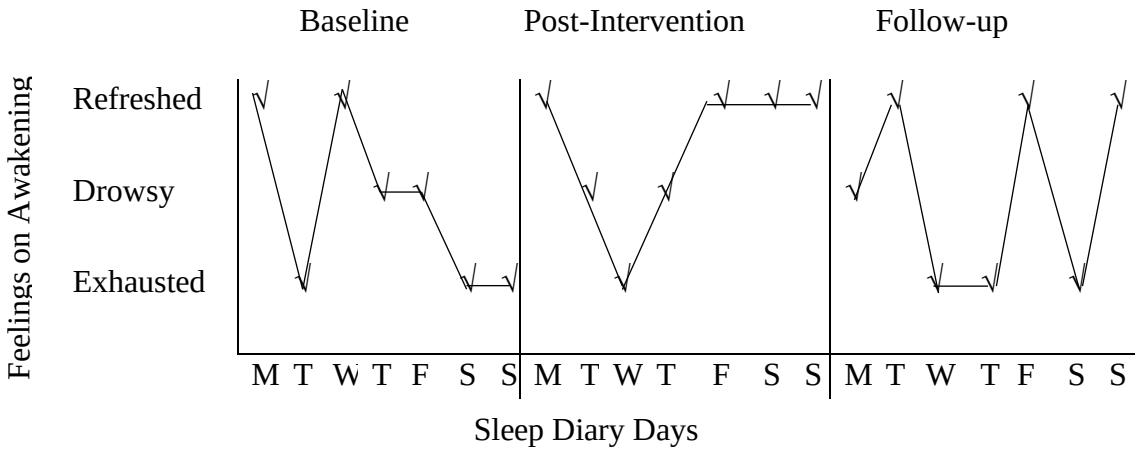

Figure 4. Amy's reported feelings on awakening from Amy's self-report sleep diary for each phase.

Feelings on awakening. Amy's reported feelings on awakening for each phase are shown in Figure 4. Her reported feelings on awakening improved from phase A to phase B_1, yet the improved positive feelings were not maintained during phase B_2.

During phase A, Amy reported feeling "Refreshed" on Monday and Wednesday mornings. She felt "Drowsy" on Thursday and Friday mornings. On Tuesday, Saturday and Sunday mornings, she felt "Exhausted". She wrote in the note section that Monday was her birthday, it was hard for her to sleep due to excitement. Post-intervention, Amy reported feeling "Refreshed" on Monday, Friday, Saturday and Sunday mornings. She felt "Drowsy" on Tuesday and Thursday mornings, and "Exhausted" on Wednesday morning. Compared with baseline, Amy reported more positive feelings. During follow-up, Amy reported waking-up feeling "Refreshed" on Tuesday, Friday and Sunday, "Drowsy" on Monday, "Exhausted" on

Wednesday, Thursday and Saturday. The improvement of positive feelings reported during the previous phase was not maintained during follow-up.

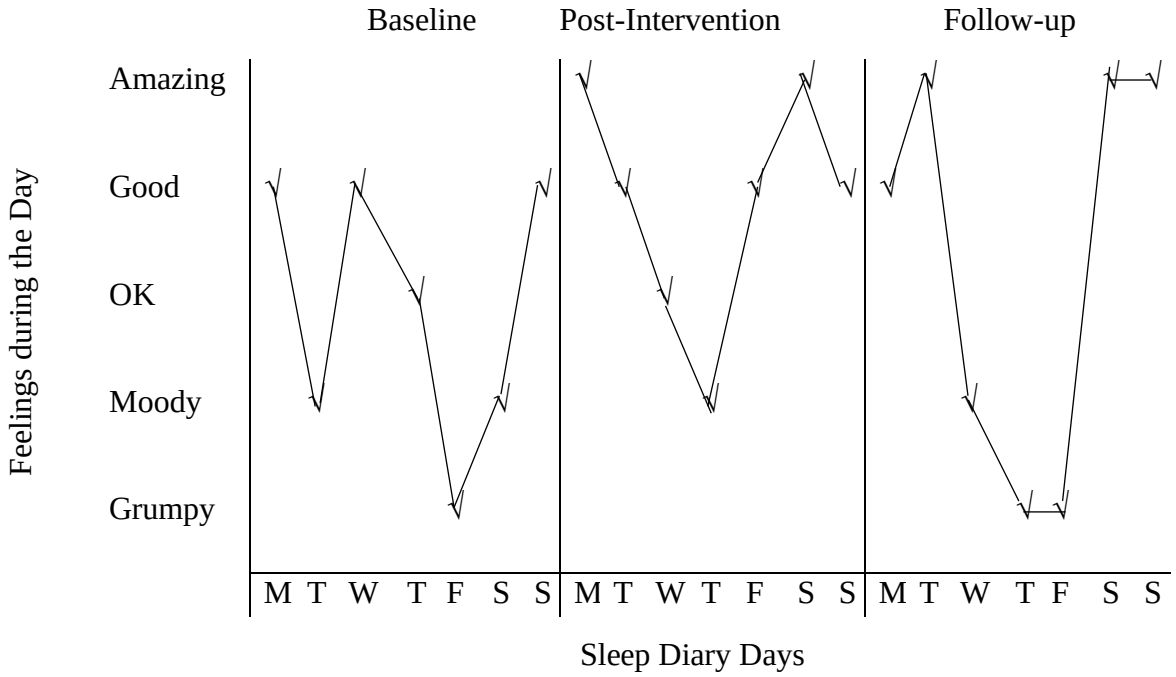

Figure 5. Amy's reported feelings during the day from Amy's self-report sleep diary for each phase.

Feelings during the day. Amy's self-reported feelings during the day for each phase are shown in Figure 5. Amy reported more positive feelings throughout the day during phase B_1 as compared with phase A. The improved day feelings was not maintained during phase B_2.

During phase A, Amy reported feeling "Good" on Monday, Wednesday and Sunday, and feeling "OK" on Thursday. She felt "Moody" on Tuesday and Saturday, and "Grumpy" on Friday. Following the intervention, Amy reported feeling "Amazing" on Monday and Saturday; "Good" on Tuesday, Friday and Sunday. She felt "OK" on Wednesday, and "Moody" on Thursday. These were better than her reports during baseline. During follow-up, Amy reported

feeling “Amazing” on Tuesday, Saturday and Sunday. She felt “Good” on Monday, “Moody” on Wednesday, “Grumpy” on Thursday and Friday. The improvement of positive feelings reported during the previous phase was not maintained as Amy reported “Grumpy” more often during follow-up.

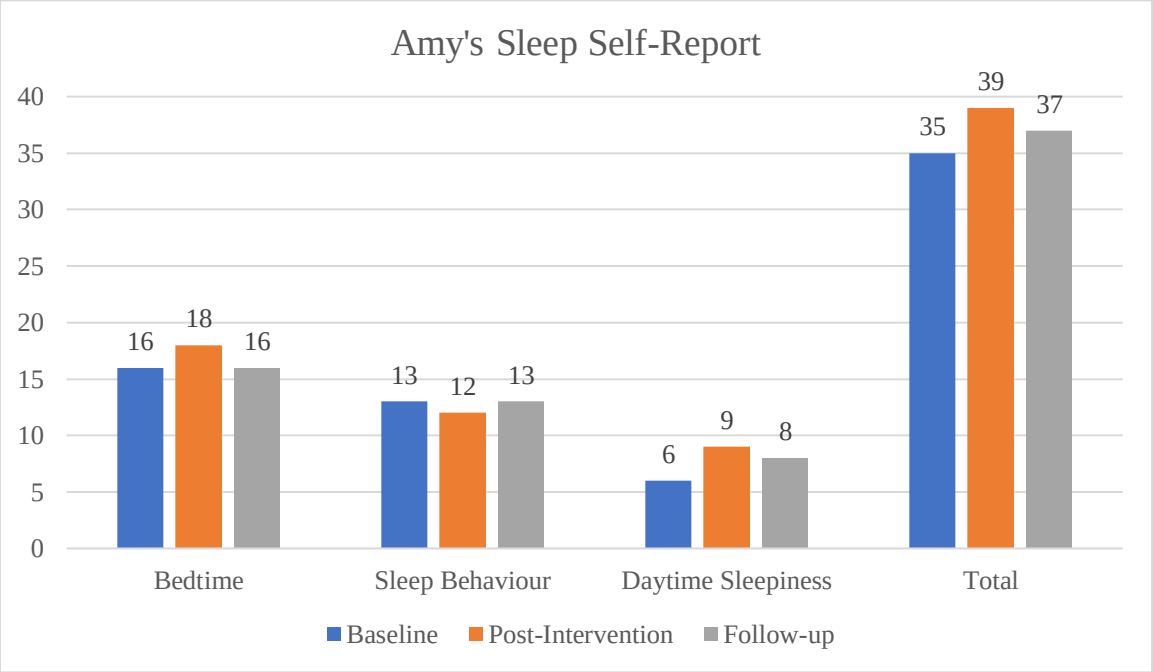

Figure 6. Amy’s Sleep Self-report scores. Higher scores indicate more problems.

Sleep-Self Report (SSR). Amy completed the SSR questionnaire at phase A, phase B_1 and phase B_2 as scheduled. Her SSR scores are illustrated by Figure 6. Amy’s SSR Total score increased from phase A to phase B_1, indicating more self-reported sleep problems. Her SSR Total score remained high at phase B_2, showing no improvement in self-reported sleep problems.

Amy’s SSR Bedtime subscale score increased from phase A to phase B_1, indicating more self-reported sleep problems at bedtime. Items Amy reported more problematic were: “Do you fall asleep in about 20 minutes”, “Is it hard for you to go to bed”, “Are you afraid of the dark”, “Do you stay up late when your parents think you are asleep”. However, post-intervention, Amy

also reported improvement in two items in the Bedtime subscale: “go to bed at the same time every night on school nights”, and “fight with your parents about going to bed”. Hence, the results for this subscale were mixed, with four items occurring more often, and two items occurring less often, post-intervention. The increased number of problems continued at phase B_2, indicating no change in the overall score in the Bedtime subscale.

Amy’s SSR Sleep Behaviour subscale score decreased slightly at phase B_1 because she reported experiencing nightmares less often. However, the improvement was not maintained at phase B_2.

Amy’s SSR Daytime Sleepiness subscale score increased from phase A to phase B_1, indicating more self-reported sleep problems during daytime. After the YIC programme, three items were reported more frequently: “Do you feel sleepy during the day”, “Do you take naps during the day”, “Do you feel rested after a night’s sleep”, which increased the Daytime Sleepiness subscale score. At follow-up, this improved slightly, as Amy stopped taking naps.

Amy’s mother set bedtime sleep rules for her at all three phases. She reported having trouble sleeping at all phases. Amy liked to go to sleep at baseline but did not like to go to sleep at phase B_1 and phase B_2.

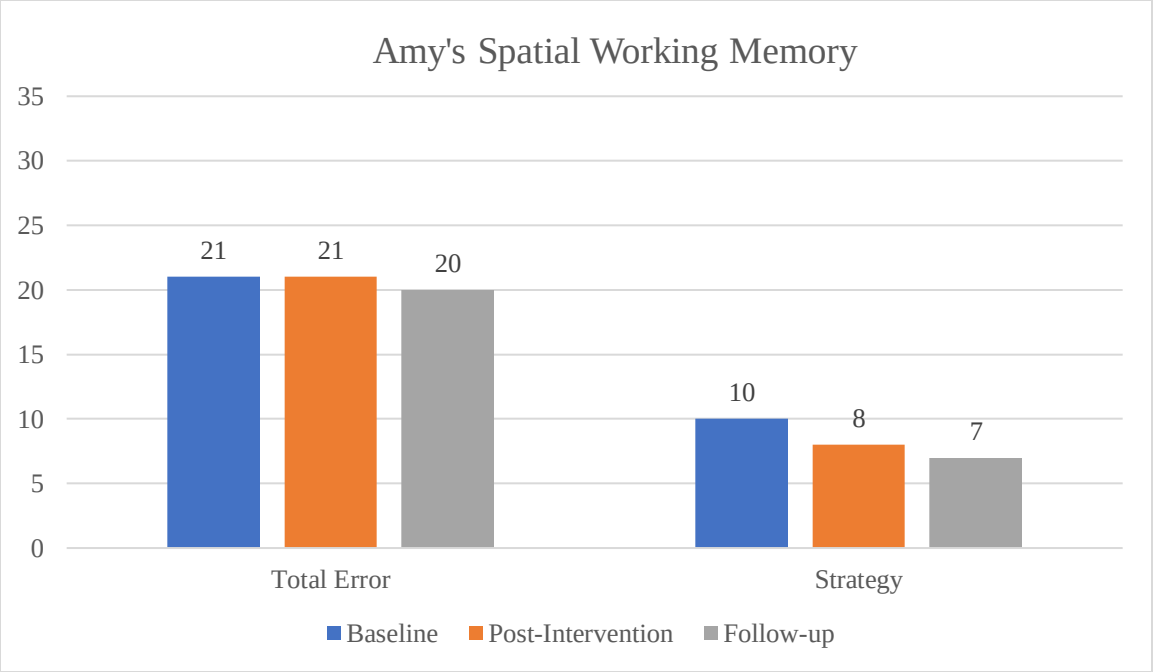

Figure 7. Amy's Spatial Working Memory Task scores. Lower scores indicate fewer errors, and improved strategy.

Spatial Working Memory (SWM). Amy completed the SWM measures for all phases as scheduled. Her total error score and strategy score are illustrated by Figure 7. Amy's total error score did not change after sleep education indicating no improvement in working memory accuracy. The accuracy score decreased by one point at follow-up, indicating little change in working memory accuracy. Amy's strategy score decreased at after sleep education and further decreased at follow-up. It showed that Amy employed a better-planned search strategy following the sleep education intervention.

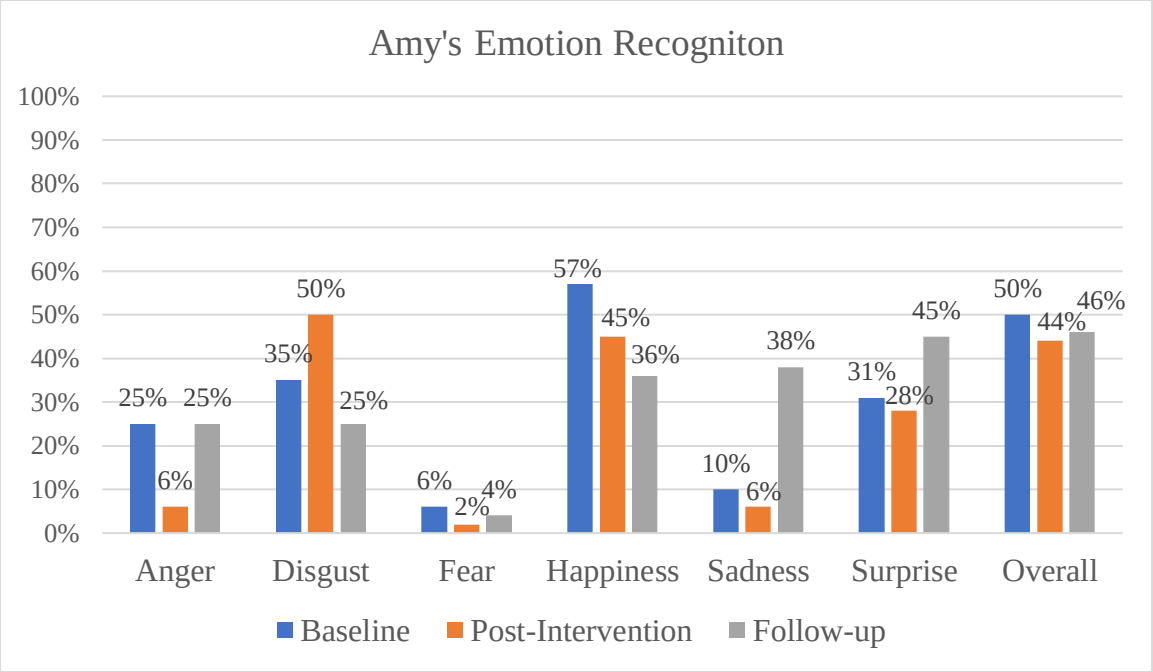

Figure 8. Amy's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion Recognition Task (ERT). Amy completed the ERT measures at all phases as scheduled. As shown in Figure 8, Amy's overall emotion recognition accuracy decreased after sleep education and remained low at follow-up, indicating a decline in emotion recognition accuracy. Among all the emotions, the accuracy of recognizing disgust increased after sleep education, however the improvement was not maintained at follow-up. Amy's overall median reaction time to pair a facial expression with an emotion decreased after sleep education (from 2.23 seconds to1.77 seconds) and further decreased at follow-up (1.19 seconds). It showed that Amy spent less time in selecting an emotion after a facial expression was presented to her, which might explain the overall decline in accuracy.

Overall, Amy spent the recommended time or more in bed for her age group during all phases. She showed some engagement in the YIC programme by working on the *Sleep Inquiry Book,* although she did not set a sleep goal. Amy's time in bed increased following the sleep education programme. This increased amount of time was gained from Amy spending more time in bed on non-school nights. The increased time in bed was not maintained during follow-up. Amy reported feeling "Refreshed" on more mornings and feeling "Amazing" during more days following the sleep education programme. These improvements were not maintained during follow-up. On the other hand, Amy reported more overall sleep problems on the SSR questionnaire after sleep education, except for the sleep behaviour subscale score, where an improvement was observed. The improvement was not maintained at follow-up. Her working memory accuracy did not change while working memory strategy improved following the sleep education programme, and the improvement in working memory strategy was maintained at follow-up. Her emotion recognition accuracy did not improve yet the speed improved after sleep education and the speed continued to improve at follow-up.

Alex. Alex demonstrated some engagement in the YIC programme by working on the *Sleep Inquiry Book* (Liberty, 2018). He did not engage fully in the *I Am A Sleep Scientist Book* learning period, (Liberty, 2018) and he did not set a sleep goal. Sleep data for post-intervention phase B_1 were not available because Alex had lost the sleep diaries he completed for that phase. Alex completed the follow-up sleep diaries during the first week of school holidays, one week later than scheduled phase B_2.

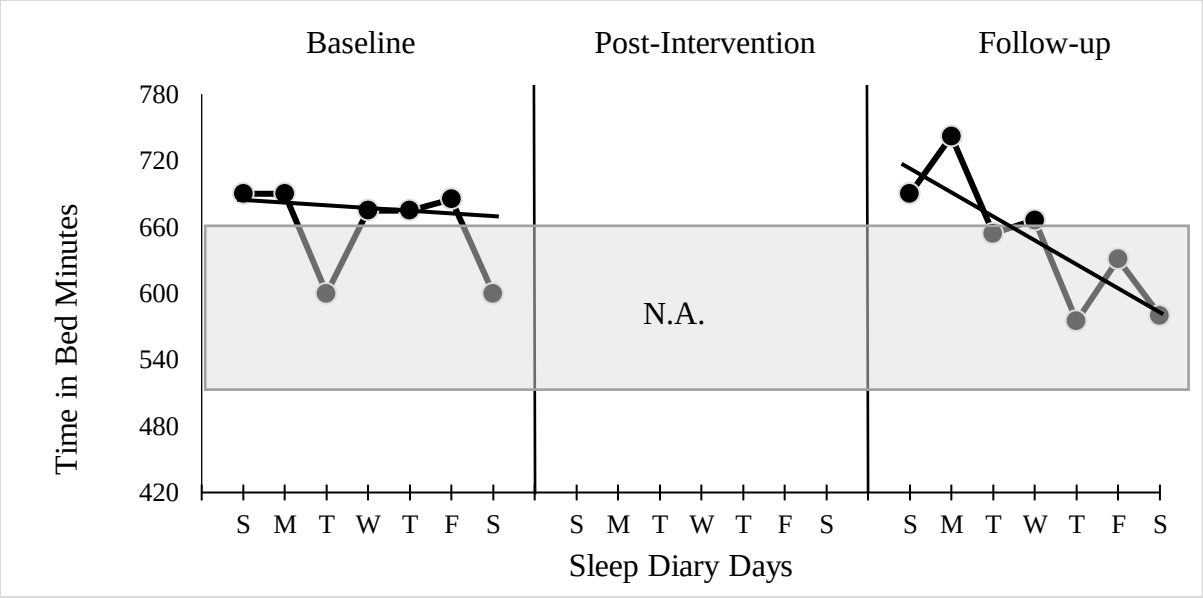

Figure 9. Repeated measures of time in bed in minutes from Alex's self-report sleep diary for phase A and phase B_2, and split-middle trend lines (Cooper et al., 2007).

Note: The shaded area shows the recommended time in bed of 9 to 11 hours for school-aged children between 6 – 13 years (Hirshkowitz et al., 2015).

Repeated Measures. Due to the lack of post-intervention sleep diaries, comparisons of sleep variables including time in bed, feelings on awakening and feelings during the day between phase A and phase B_1 were not available for Alex.

Time in bed. Alex's time in bed during the baseline phase A and during the follow-up phase B_2 is presented in Figure 9. Alex's average time in bed decreased slightly during phase B_2 as compared with phase A. Comparing Alex's time in bed with that recommended for his age group, Alex spent the recommended time or more in bed every night during both phases.

Trend analysis indicates that his time in bed remained stable during baseline, and decreased during follow-up. Alex's average time in bed during baseline was 659.29 minutes (SD = 40.97). He spent more time in bed on school nights than non-school nights (Mean = 666, SD = 37.65, vs. Mean = 645, SD = 63.64). He spent the most amount of time in bed on Sunday and Monday nights, and the least amount of time in bed on Tuesday and Saturday nights. During the

follow-up, Alex's average time in bed was 648.29 minutes (SD= 59.44), about eleven minutes less per night compared with the average time in bed during phase A. However, as the sleep diaries were completed during the term break, there were no school nights. Alex spent the least amount of time in bed on Thursday night and the most amount of time on Monday night.

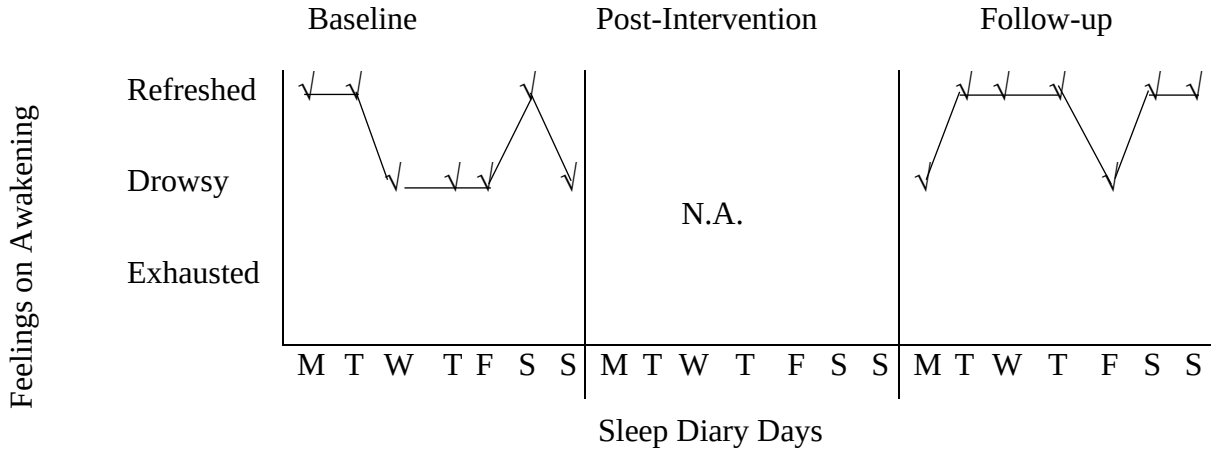

Figure 10. Alex's reported feelings on awakening from Alex's self-report sleep diary for phase A and phase B_2.

Feelings on awakening. Alex's self-reported feelings on awakening for phase A and phase B_2 are illustrated by Figure 10. Alex reported feeling refreshed on more mornings during phase B_2 than phase A, showing an improvement in feelings on awakening.

During phase A, Alex reported waking-up feeling "Refreshed" on Monday, Tuesday and Saturday. He reported feeling "Drowsy" on the rest mornings of the week. At the follow-up phase B_2, Alex reported feeling "Refreshed" on Tuesday, Wednesday, Thursday, Saturday and Sunday mornings. He reported feeling "Drowsy" on Monday and Friday mornings. He reported waking-up feeling "Refreshed" on five out of seven mornings compared with four out of seven mornings during baseline, indicating improvement in positive feelings. However, as the sleep

diaries were completed during the school holidays, the improvement might be a result of the difference between school days and non-school days.

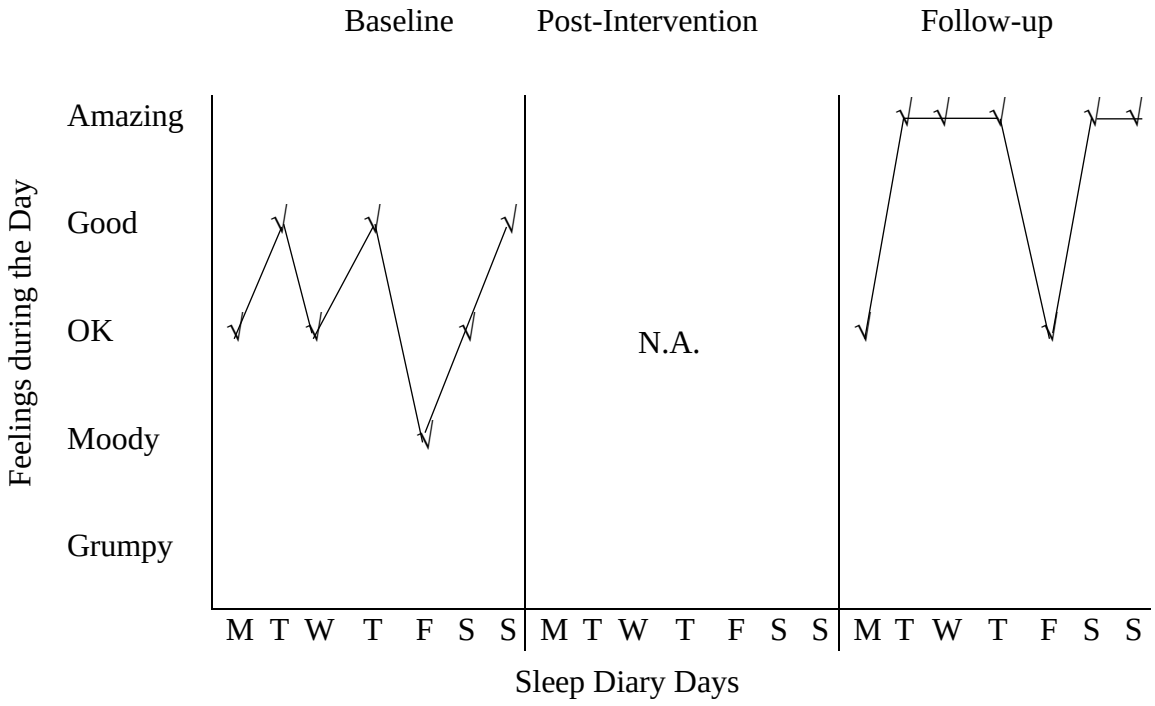

Figure 11. Alex's reported feelings during the day from Alex's self-report sleep diary for phase A and phase B_2.

Feelings during the day. Alex's reported feelings during the day for phase A and phase B_2 are illustrated by Figure 11. Compared to phase A, Alex reported more positive feelings during the day throughout phase B_2, indicating an improvement in positive daytime feelings at follow-up.

During phase A, he reported feeling "Good" on Tuesday, Thursday and Sunday. He felt "OK" on Monday, Wednesday and Saturday. On Friday, he felt "Moody". Alex reported feeling "Amazing" during the day on Tuesday, Wednesday, Thursday, Saturday and Sunday. He

reported feeling "OK" on Monday and Friday. Compared with baseline, he reported feeling "Amazing" and/or "Good" on more days.

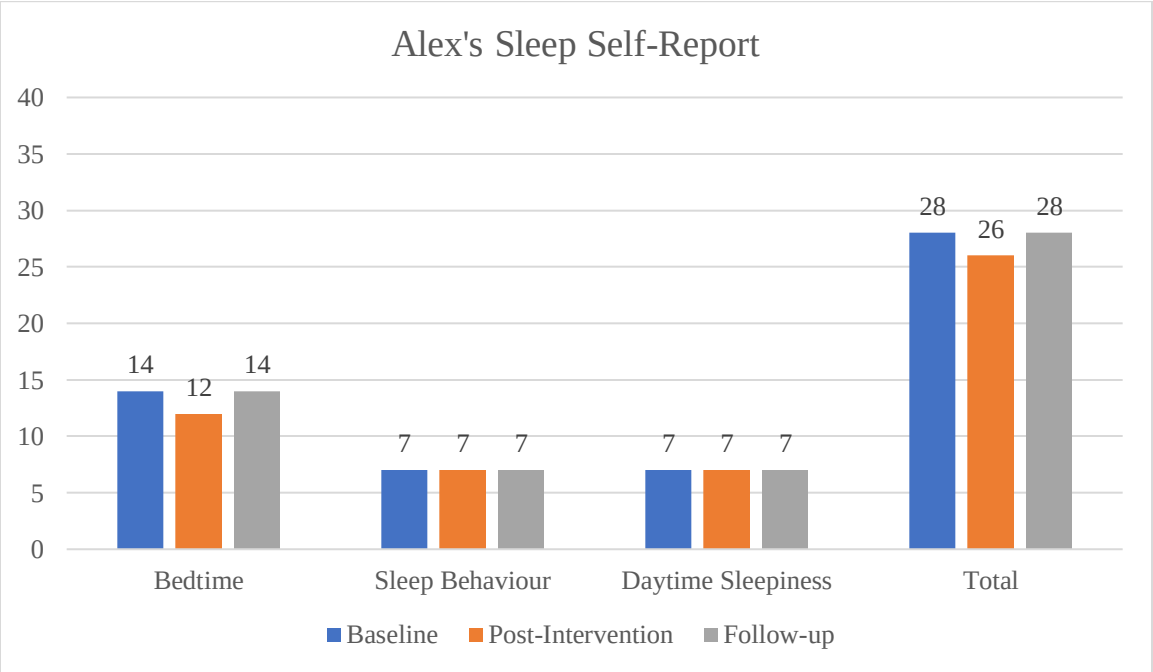

Figure 12. Alex's Sleep Self-report scores. Higher scores indicate more problems.

Sleep-Self Report (SSR). Alex completed the SSR questionnaire for all phases as scheduled. The SSR scores are illustrated by Figure 12. Alex's SSR Total score decreased at the post-intervention phase B_1 as compared with the baseline phase A, indicating fewer sleep problems. However, the improvement was not maintained at the follow-up phase B_2.

An improvement in reported sleep problems around bedtime was observed from SSR Bedtime subscale scores, where Alex reported that it was "not hard for him to go to bed at all" and that he was usually "ready for bed at his usual bedtime". These improvements were not maintained at the follow-up phase B_2. Scores on the SSR Sleep Behaviour and SSR Daytime sleepiness subscales did not change at phase B_1 and phase B_2. However, Alex reported not "waking up at night" anymore at phase B_1 and phase B_2. He felt he slept too much at phase B_2.

Alex's mother set bedtime sleep rules for him at all three phases. Alex reported having trouble sleeping at phase A, and only sometimes having trouble sleeping at phase B_1 and phase B_2. Alex liked to go to sleep sometimes at baseline, he liked to go to sleep at all times after sleep education. He reported liking to go to sleep sometimes at follow-up.

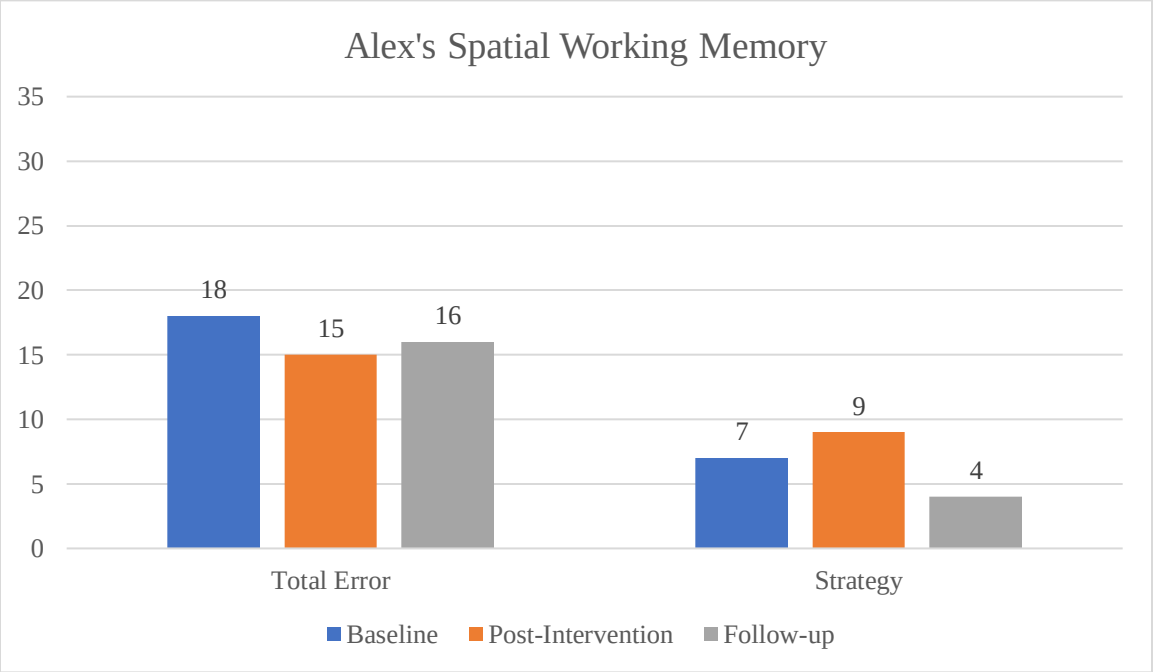

Figure 13. Alex's Spatial Working Memory Task scores. Lower scores indicate fewer errors, and improved strategy.

Spatial Working Memory (SWM). Alex completed the SWM measures for all phases as scheduled. Alex's total error score decreased after sleep education (Figure 13), indicating improvement in working memory accuracy. The improvement was not maintained at follow-up. Alex's strategy score increased after sleep education, showing no improvement in working memory strategy. However, his strategy score at follow-up was lower than baseline, showing that Alex applied a better-planned search strategy at follow-up.

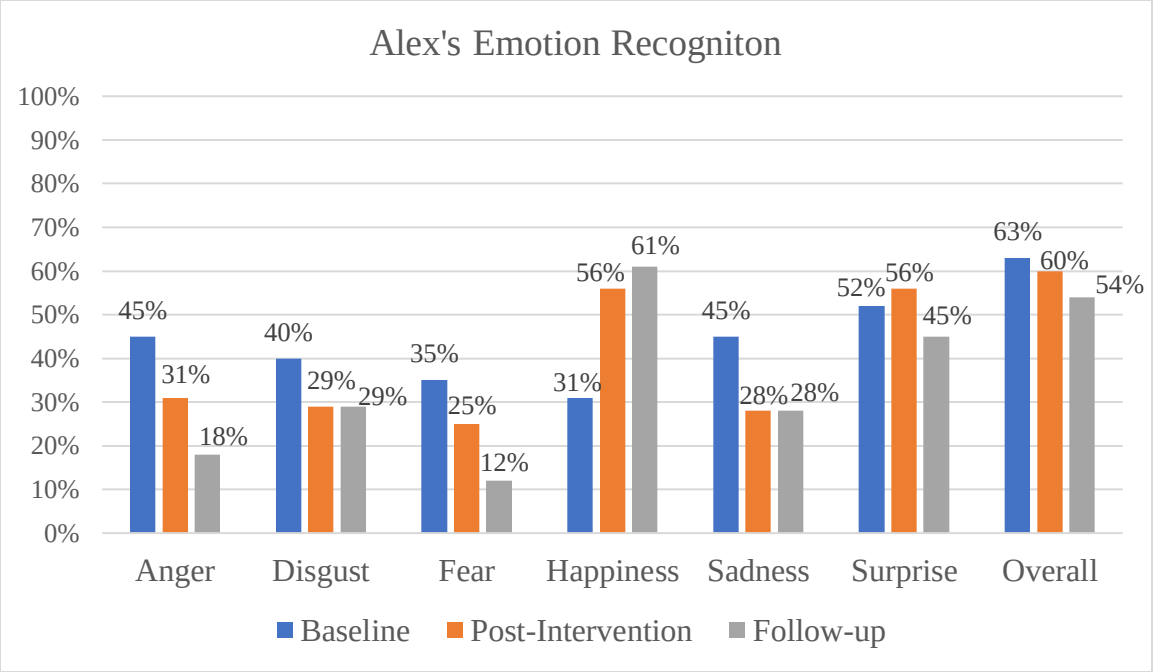

Figure 14. Alex's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion Recognition Task (ERT). Alex completed the ERT measures for all phases as scheduled. The overall accuracy of emotion recognition decreased at the post-intervention phase B_1 and continued to decrease at the follow-up phase B_2 (Figure 14), indicating no improvement in emotion recognition accuracy. Among all the emotions, the accuracy in recognizing happiness increased at phase B_1 and continued to increase at phase B_2, showing an improvement in emotion recognition accuracy of happiness. The accuracy in recognizing surprise increased at phase B_1 but the improvement was not maintained at phase B_2.

Alex's overall median reaction time to pair a facial expression with an emotion increased from 1.41 seconds at phase A to 2.05 at phase B_1. It showed that it took Alex longer to select an emotion after a facial expression was presented to him at phase B_1, indicating no improvement in speed. No improvement in speed was observed at phase B_2 either (1.57 seconds).

Overall, Alex showed some engagement in the programme, although he did not set a sleep goal. However, sleep diaries for the post-intervention phase B_1 were missing, and sleep diaries for the follow-up phase B_2 were completed during term breaks. He spent the recommended time or more in bed during both phase A and phase B_2. Alex's average time in bed decreased slightly during phase B_2 as compared with phase A. He reported feeling "Refreshed" on more mornings and feeling "Amazing" during more days in phase B_2 than phase A. Alex reported fewer sleep problems on the SSR questionnaire at phase B_1, showing improvement in sleep problems. However, the improvement was not maintained at phase B_2. Alex's working memory accuracy improved at phase B_1, and the improvement was not maintained at phase B_2. An improvement in working memory strategy was observed at follow-up only. Alex's overall emotion accuracy did not improve. Nevertheless, the accuracy in recognizing happiness increased at phase B_1 and the improvement was maintained at phase B_2, whereas the accuracy in recognizing surprise increased at phase B_1 but the improvement was not maintained at phase B_2. The overall median reaction time did not improve, indicating no improvement in emotion recognition speed.

Albert. Albert showed some engagement in the YIC programme by completing the *Sleep Inquiry Book* (Liberty, 2018). Albert had been sick and away from school during the *I Am A Sleep Scientist Book* learning period. He did not set a sleep goal.

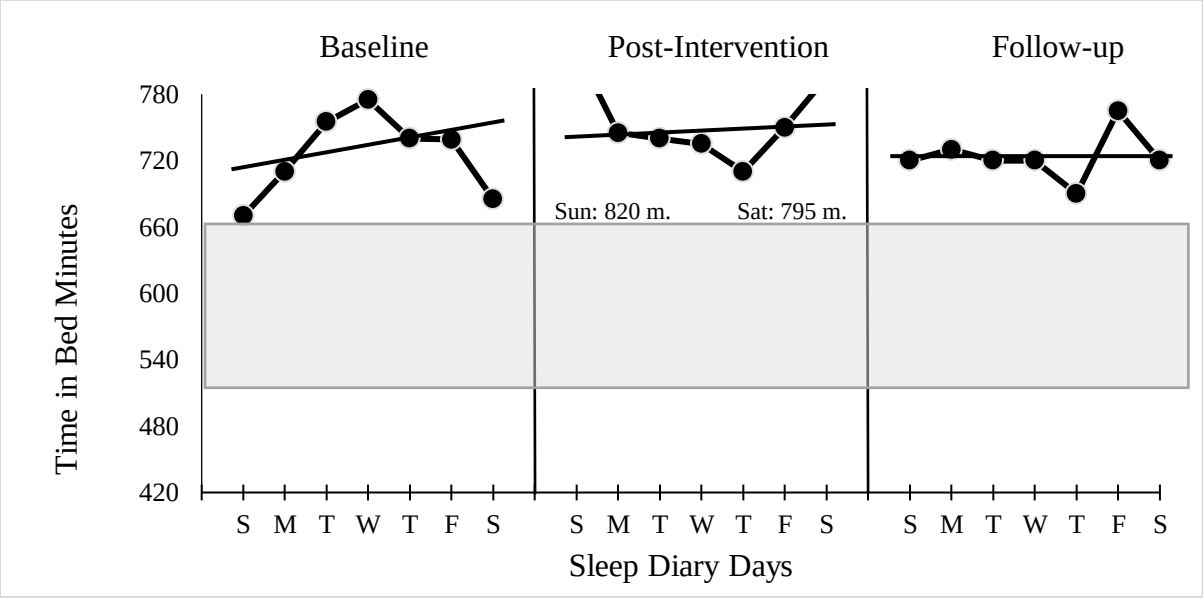

Figure 15. Repeated measures of time in bed in minutes from Albert's self-report sleep diary for each phase, and split-middle trend lines (Cooper et al., 2007).

Note: The shaded area shows the recommended time in bed of 9 to 11 hours for school-aged children between 6 – 13 years (Hirshkowitz et al., 2015).

Repeated Measures.

Time in bed. Albert's time in bed during all phases is presented in Figure 15. There was an improvement in Albert's time in bed from phase A to phase B_1, and this was stable through phase B_2. Albert spent more time in bed than the recommended time every night during all phases.

Trend analysis indicates that his time in bed increased during phase A and also increased during phase B_1. He spent the least amount of time in bed on Thursday night and the most amount of time on Sunday night. He recalled waking up on Wednesday night and stayed awake for 30 mins due to a bad dream. Compared with phase A, Albert spent more time in bed on Sunday, Monday, Friday and Saturday nights; and he stayed in bed for more than the

recommended length of time for his age every night during phase B_1. Trend analysis indicates that his time in bed was stable during phase B_2.

During the baseline phase A, Albert's average time in bed was 724.86 minutes (SD = 38.02). He spent more time in bed on school nights than on non-school nights (Mean = 730, SD = 41.08; vs. Mean = 712, SD = 38.18). He spent the least amount of time in bed on Sunday night and the most amount of time in bed on Wednesday night. During the post-intervention phase B_1, Albert's average time in bed was 756.43 minutes (SD = 37.83), which was 31.57 minutes more than his average time in bed during phase A. Albert spent more time in bed on weekend nights than on school nights (Mean = 772.5 minutes, SD = 31.82, vs. Mean = 750, SD = 41.38). Compared with baseline, Albert spent on average 20 minutes more in bed on every school night (Mean = 750, SD = 41.38, vs. Mean = 730, SD = 41.08), and 60 minutes more per non-school night after sleep education (Mean = 772.5, SD = 31.82, vs. Mean = 712, SD = 38.18). During the follow-up phase B_2, the calculation of time in bed on Saturday night was adjusted by taking an hour away due to the start of day-light savings in New Zealand. The mean time in bed was 723.57 minutes (SD = 22.12), which was about 33 minutes less than the mean time in bed of the previous phase. Albert spent more time in bed on weekend nights than school nights (Mean = 742.5 minutes, SD = 31.82, vs. Mean = 716 minutes, SD = 15.17). Compared with the previous phase, Albert spent 34 minutes less in bed on average per school night (Mean = 716 minutes, SD = 15.17, vs. Mean = 750, SD = 41.38), and 30 minutes less on average per non-school night (Mean = 742.5 minutes, SD = 31.82, vs. Mean = 772.5 minutes, SD = 31.82).

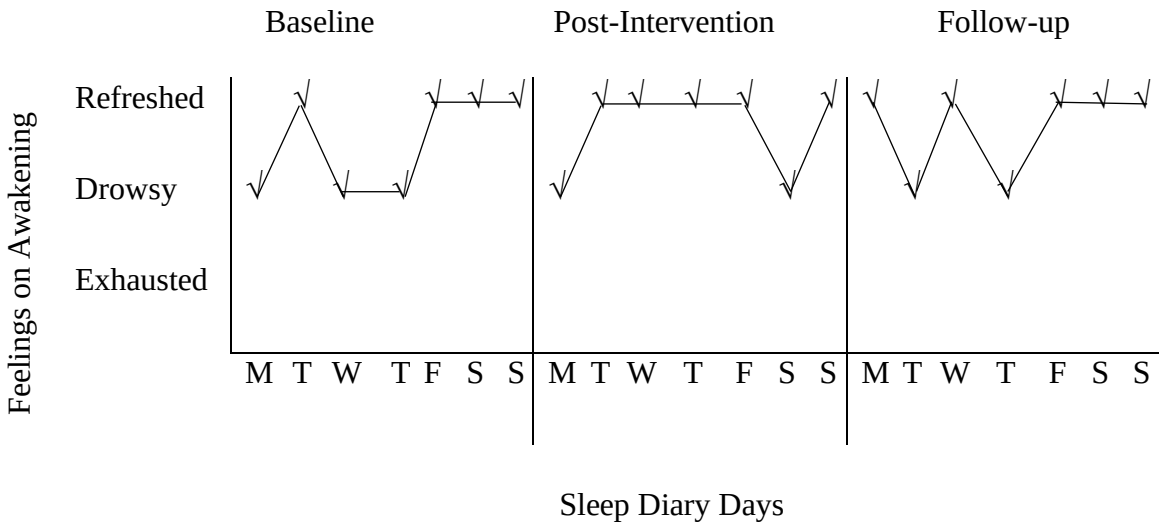

Figure 16. Albert's reported feelings on awakening from Albert's self-report sleep diary for each phase.

Feelings on awakening. Albert's reported feelings on awakening for each phase are illustrated by Figure 16. He reported more positive feelings on awakening during phase B_1 than phase A, and these were maintained through phase B_2.

During the baseline phase A, Albert reported waking-up feeling "Refreshed" on Tuesday, Friday, Saturday and Sunday. He reported feeling "Drowsy" on Monday, Wednesday and Thursday mornings. After sleep education, Albert reported feeling "Refreshed" on Tuesday, Wednesday, Thursday, Friday and Sunday mornings. He felt "Drowsy" on the other two mornings. These were better than his reports during baseline. During phase B_2, Albert reported feeling "Refreshed" on Monday, Wednesday, Friday, Saturday and Sunday mornings. He felt "Drowsy" on Tuesday and Thursday mornings. These were similar to his reports from the previous phase.

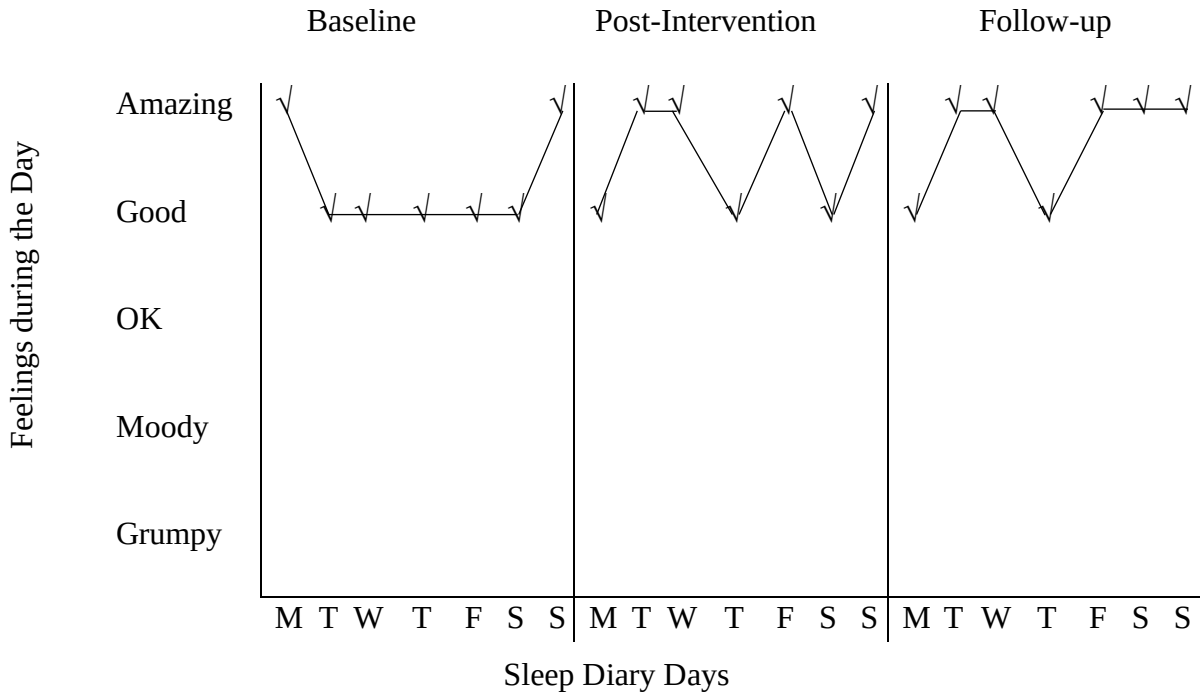

Figure 17. Albert's reported feelings during the day from Albert's self-report sleep diary for each phase.

Feelings during the day. Figure 17 showed Albert's self-reported feelings during the day for each phase. Albert reported positive feelings during the day through all phases. In addition, he reported feeling amazing more often after sleep education and during follow-up, indicating more elevated feelings.

During phase A, Albert reported feeling "Amazing" on Monday and Sunday where he felt "Good" on the rest of the days. During phase B_1, Albert reported feeling "Amazing" on Tuesday, Wednesday, Friday and Sunday. He felt "Good" on the rest of the days. These positive feelings were even better than his reports during baseline. Albert reported feeling "Amazing" on Tuesday, Wednesday, Friday, Saturday and Sunday. He felt "Good" on the rest of the phase B_2 days. These were similar to his reports from the previous phase.

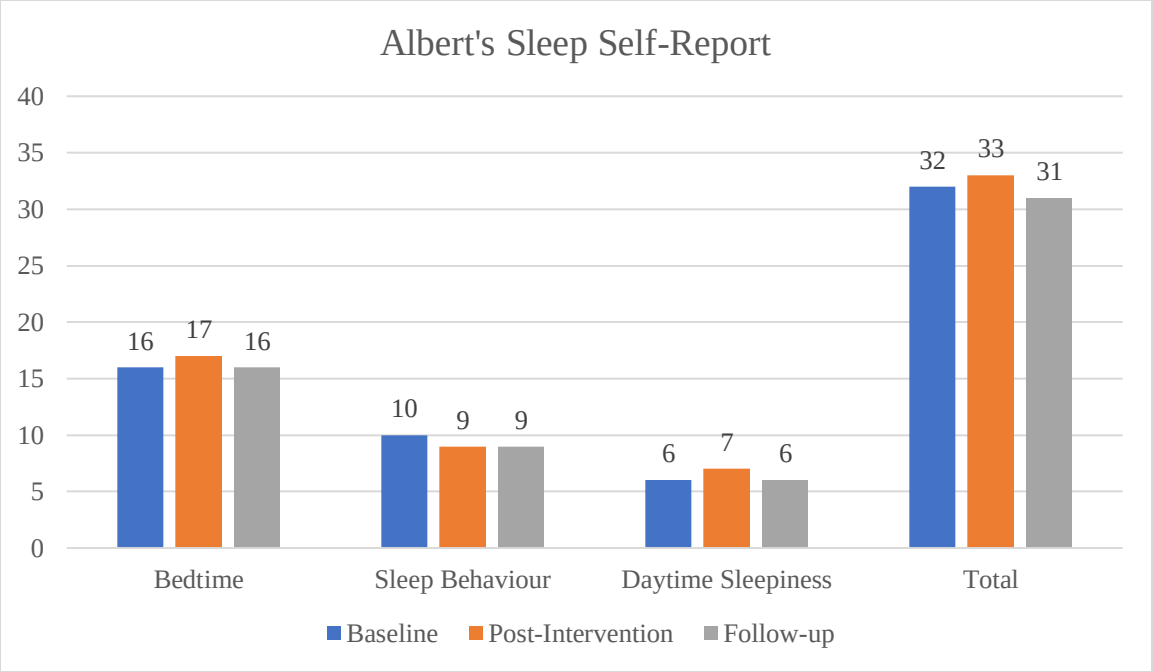

Figure 18. Albert's Sleep Self-report scores. Higher scores indicate more problems.

Sleep-Self Report (SSR). Albert completed the SSR questionnaire at all phases as scheduled. His SSR scores are illustrated by Figure 18. Albert's SSR Total scores at phase B_1 and B_2 were similar to his reports at baseline, indicating little change in self-reported total sleep problems.

Compared with baseline, Albert's SSR Bedtime score, SSR Sleep Behaviour score, and SSR Daytime Sleepiness score changed by one point respectively after sleep education. The items that indicated improvement in reported sleep problems were: "Is it hard for you to go to bed", "Do you stay up late when your parents think you are asleep", "Do you wake up at night when your parents think you are asleep". Items that Albert reported as being more problematic were: "Do you fall asleep in about 20 minutes", "Do you fight with your parents about going to bed", and "Do you have trouble waking in the morning".

Both of Albert's parents set bedtime sleep rules for him at all three phases. He reported having trouble sleeping at phase A, and only sometimes having trouble sleeping at phase B_1 and phase B_2. Albert liked to go to sleep sometimes at baseline, he liked to go to sleep at all times at phase B_1. He reported liking to go to sleep sometimes at phase B_2.

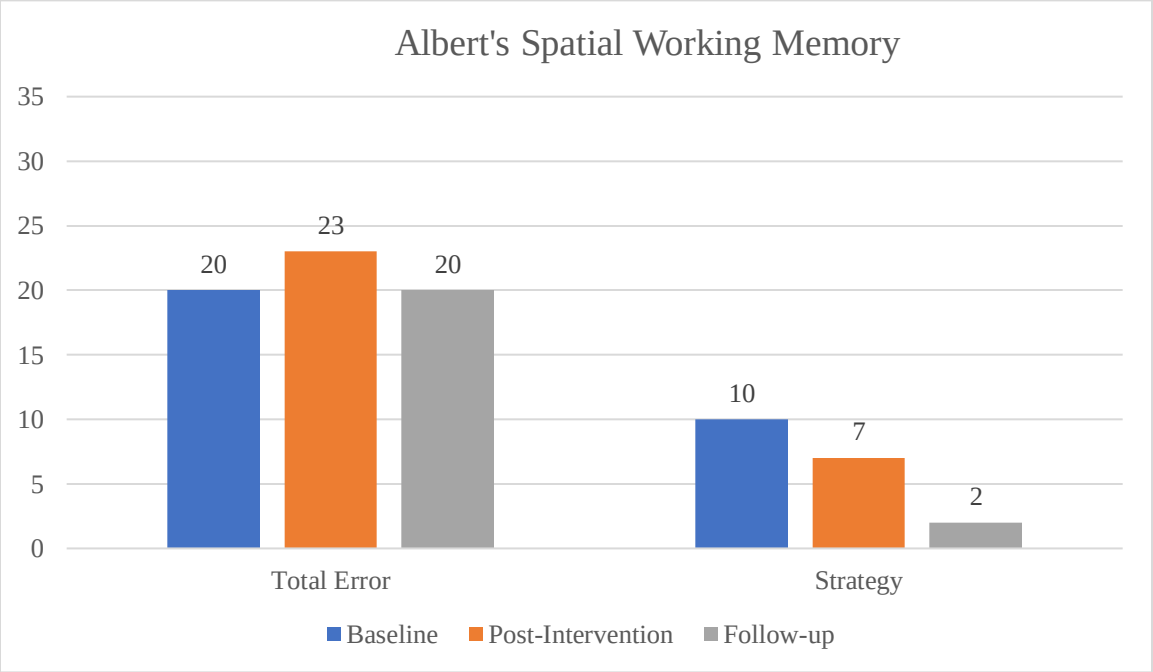

Figure 19. Albert's Spatial Working Memory Task scores. Lower scores indicate fewer errors, and improved strategy.

Spatial Working Memory (SWM). Albert completed the SWM measures for all phases as scheduled. As shown in figure 19, Albert's total error score increased at the post-intervention phase B_1, indicating deterioration in working memory accuracy. The total error score at the follow-up phase B_2 improved to baseline level, suggesting no overall change in working memory accuracy. Albert's strategy score decreased at phase B_1 and further decreased at phase B_2. It showed that Albert employed a better-planned search strategy after the intervention, and the improvement was maintained at follow-up.

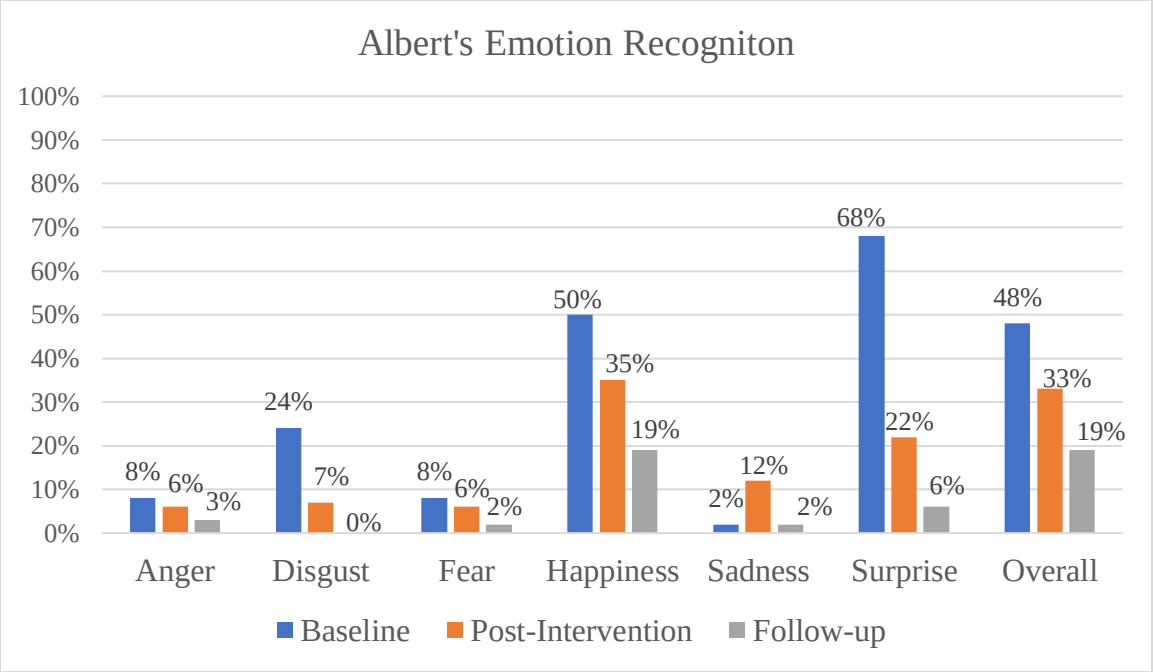

Figure 20. Albert's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion Recognition Task (ERT). Albert completed the ERT measures for all phases as scheduled. The overall accuracy of emotion recognition decreased at the post-intervention phase B_1 and continued to decrease at the follow-up phase B_2 (Figure 20). No improvement in emotion recognition accuracy was observed. Of all the emotions, the accuracy of recognizing sadness increased at phase B_1, yet the improvement was not maintained at phase B_2. Albert's overall median reaction time to pair a facial expression with an emotion decreased from 2.02 seconds at baseline to 1.77 seconds after sleep education, and it further decreased to 0.67 seconds at follow-up. It showed that Albert spent less time in selecting an emotion after a facial expression was presented to him, which might explain the overall decline in accuracy.

Overall, Albert showed some engagement in the programme, although he did not set a goal. He spent more than the recommended time in bed for his age group every night during all phases. Albert's time in bed increased after sleep education. The increased time in bed was not

maintained during follow-up. His reports of feelings on awakening and feelings during the day improved after sleep education; and these were maintained during follow-up. Albert's SSR scores did not change much across three phases. His working memory strategy improved although accuracy did not, and the improvement was maintained. Albert's emotion recognition accuracy did not improve, but speed improved, suggesting he was quicker with tasks but making more mistakes.

Children - Full Engagement

Max. Max was fully engaged in the YIC programme (Liberty, 2018). He completed both workbooks. He told the study researcher that he set a sleep goal. His sleep goal was to "fall asleep in fifteen minutes", but he said he did not achieve it. However, conversation with Max during phase B_2 revealed that Max was not waking up in the middle of the night anymore. He went to bed earlier and woke-up earlier. He reported sleeping better in general.

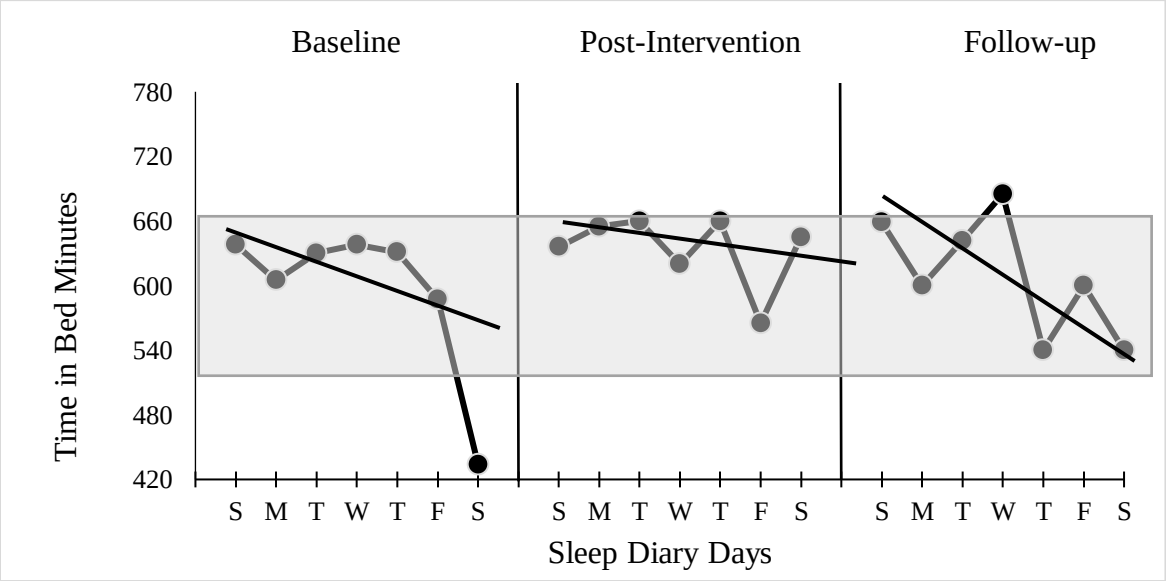

Figure 21. Repeated measures of time in bed in minutes from Max's self-report sleep diary for each phase, and split-middle trend lines (Cooper et al., 2007).

Note: The shaded area shows the recommended time in bed of 9 to 11 hours for school-aged children between 6 – 13 years (Hirshkowitz et al., 2015).

Repeated Measures. Instead of completing the sleep diaries for phase B_1 during the last week of school term two, Max completed the sleep diaries during the first week of school term three, after having a two-week school term break.

Time in bed. Max's time in bed during all phases is presented in Figure 21. There was an improvement in Max's time in bed from phase A to B_1, the improved time in bed was not maintained during phase B_2. Comparing Max's time in bed with that recommended for his age group, he slept the recommended length of time or longer on all nights during phase B_1 and B_2, which was an improvement from phase A.

Trend analysis indicates that Max's time in bed decreased during phase A. After sleep education, trend analysis shows that his time in bed decreased, however, he spent more time in bed on Monday, Tuesday, Thursday and Saturday night after sleep education. Trend analysis indicates that his time in bed decreased during the follow-up phase. Max spent more time in bed on every night except for Monday and Thursday nights of the previous phase.

During the baseline phase A, Max's mean time in bed was 594.71 minutes (SD = 73.38). He spent more time in bed on school nights than non-school nights (Mean = 628.4 minutes, SD = 13.61 vs. Mean = 510.5 minutes, SD = 108.19). He spent the least amount of time in bed on Saturday night with no particular reason and the most amount of time in bed on Sunday night. Post-intervention, Max's average time in bed was 634.43 (SD = 33.85), 39 minutes more than his average time in bed of the previous phase. When comparing the average time in bed on school nights, Max spent seventeen minutes more on average on school nights during phase B_1 (Mean = 646.2, SD = 17.67 vs. Mean = 628.4, SD =13.61) than phase A. Max spent 605 minutes (SD = 56.57) in bed on average on non-school nights, 95 minutes more than an average non-school night of the previous phase. During the follow-up phase B_2, Max's time in bed on Saturday

night was adjusted by taking an hour away due to the start of day-light savings in New Zealand. The mean time in bed during this phase was 609.43 minutes (SD = 56.34), 25 minutes less than the mean time in bed of the previous phase. Max's mean time in bed on school nights was 625.2 minutes (SD = 56.78), 21 minutes less than the previous phase. Max's average time in bed for non-school nights was 570 minutes (SD = 42.43), 35 minutes less per non-school night than the previous phase. Max spent more time in bed on school nights than on non-school nights. He had the shortest time in bed on Thursday night and the longest on Wednesday night.

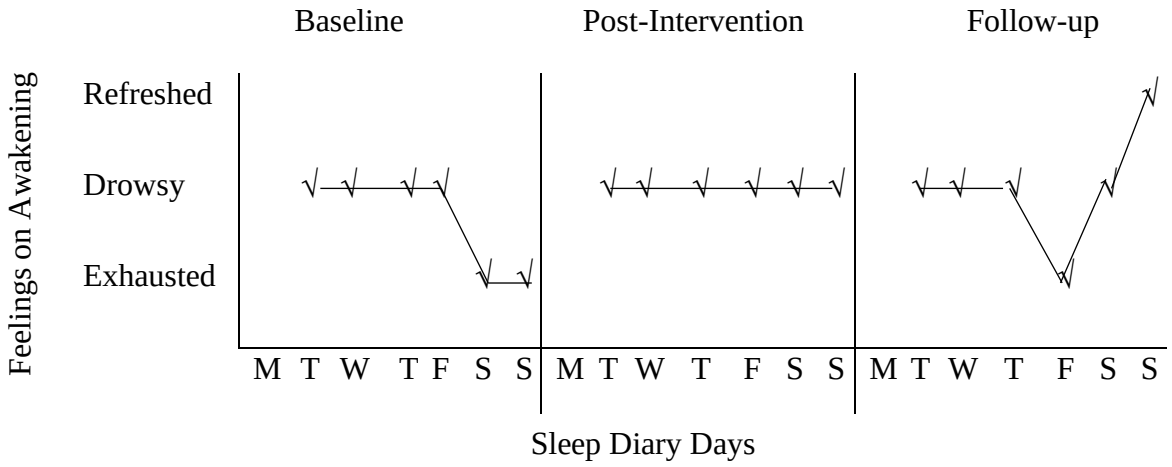

Figure 22. Max's reported feelings on awakening from Max's self-report sleep diary for each phase.

Feelings on awakening. Max's reported feelings on awakening for each phase are illustrated by Figure 22. His reported feelings on awakening were generally better during phase B_1 and phase B_2 compared with phase A.

During the baseline phase A, where data on Monday morning was not available, Max reported waking-up feeling "Drowsy" on Tuesday, Wednesday Thursday and Friday, and "Exhausted" on Saturday and Sunday. After sleep education, Max reported feeling "Drowsy" on every morning except for Monday when he forgot to record, these reports were still better than

his reports during baseline because Max did not feel "Exhausted" any longer. During follow-up, Max reported feeling "Refreshed" on Sunday morning, feeling "Drowsy" on Tuesday, Wednesday, Thursday and Saturday mornings. He felt "Exhausted" when waking up on Friday morning. He did not record Monday morning. These reports were more irregular than his reports from the previous two phases, however, he started to report positive feelings during this phase.

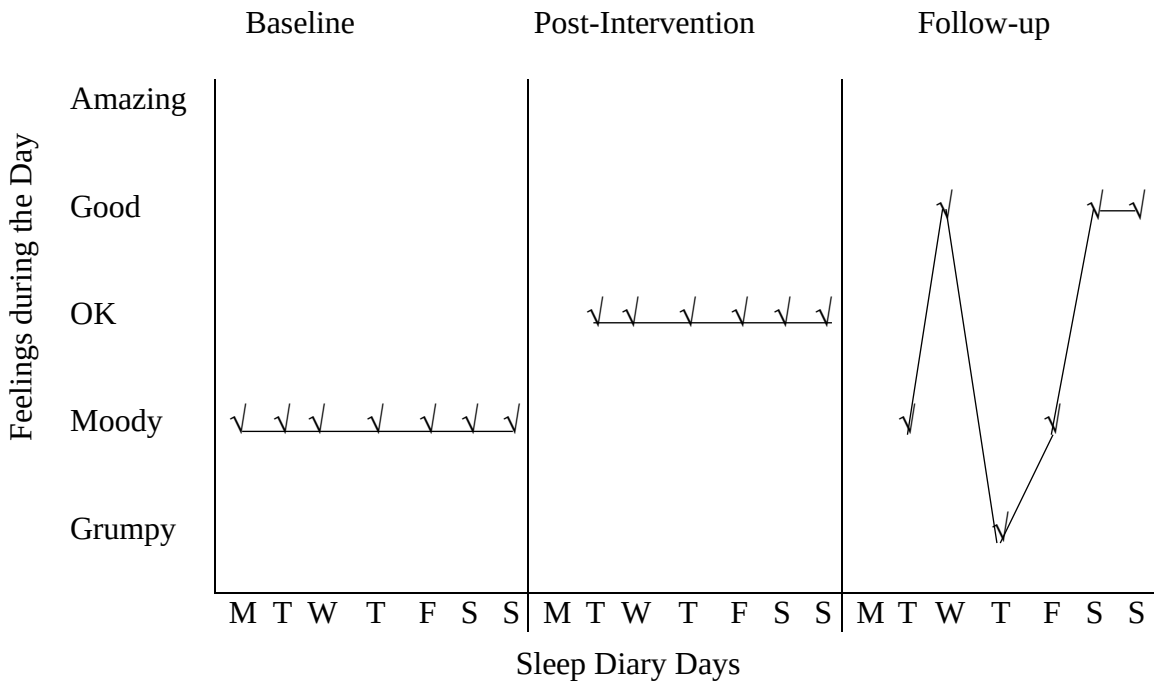

Figure 23. Max's reported feelings during the day from Max's self-report sleep diary for each phase.

Feelings during the day. Max's self-reported feelings during the day for each phase are illustrated by Figure 23. Max's feelings during the day improved after sleep education however his feelings during the day were more fluctuated through follow-up.

During phase A, Max reported feeling "Moody" every day. Post-intervention, Max reported feeling "OK" during the day every day except for Monday when he forgot to record.

Compared with baseline where he reported feeling "Moody" every day, an improvement in feeling was observed after sleep education. During follow-up, Max reported feeling "Good" on Wednesday, Saturday and Sunday. He felt "Moody" on Tuesday and Friday; and "Grumpy" on Thursday. He did not record Monday. Although more positive feelings were reported, Max's reports through this phase were more fluctuated than his reports from the previous phase.

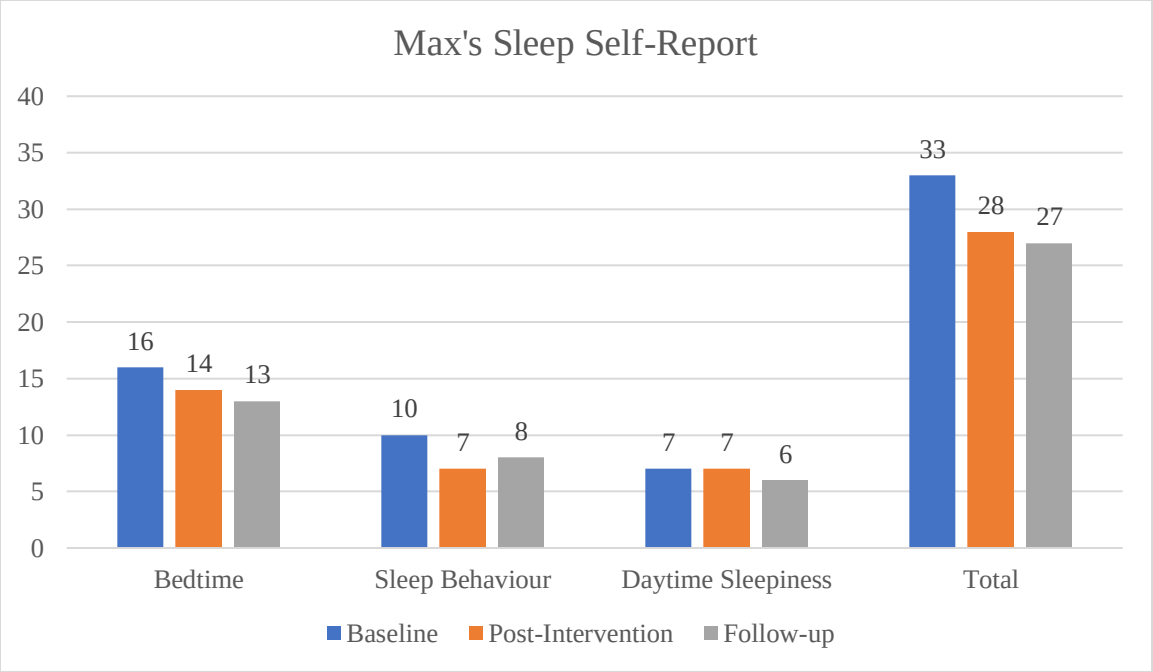

Figure 24. Max's Sleep Self-report scores. Higher scores indicate more problems.

Sleep-Self Report (SSR). Max completed the SSR questionnaire for all phases as scheduled. His SSR scores are illustrated by Figure 24. Max reported fewer sleep problems after sleep education, and these improvements were maintained at follow-up.

Max's SSR Bedtime, SSR Sleep Behaviour, and SSR Total scores decreased following the YIC programme as compared with baseline. Items Max rated suggesting improvement were "Do you fight with your parents about going to bed", "Do you stay up late when your parents think you are asleep", Do you wake up at night when your parents think you are asleep", "Do

you have trouble falling back to sleep if you wake up during the night". The improvement was maintained during the follow-up phase. Items showed further improvement at follow-up were "Do you go to bed at the same time every night on school nights", "Do you fall asleep in about 20 minutes", and "Do you feel sleepy during the day".

Both Max's parents set bedtime sleep rules for him at all three phases. Max reported having trouble sleeping at phase A and phase B_1, and sometimes having trouble sleeping at phase B_2. Max did not like to go to sleep at all phases.

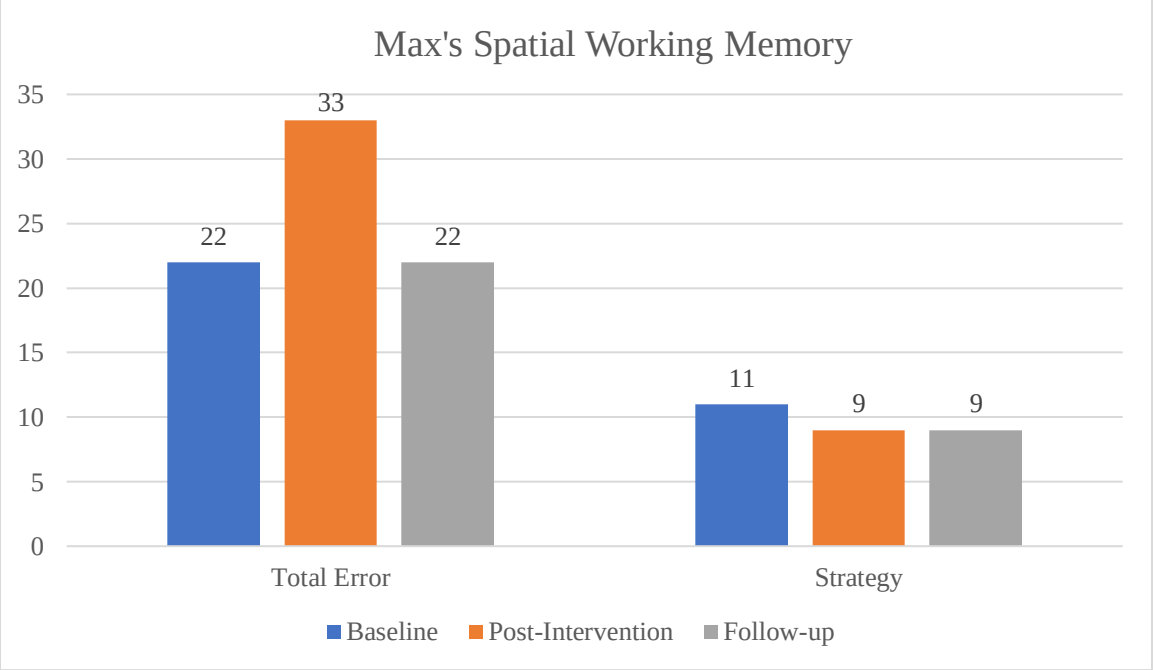

Figure 25. Max's Spatial Working Memory Task scores. Lower scores indicate fewer errors, and improved strategy.

Spatial Working Memory (SWM). Max completed the SWM measures for all phases as scheduled. Max's total error score increased following the YIC programme and decreased to baseline level at follow-up (Figure 25), indicating no improvement in working memory accuracy. Max's strategy score decreased after the Sleep Education programme. It shows that Max applied

a better-planned search strategy after sleep education. The improvement was maintained at follow-up.

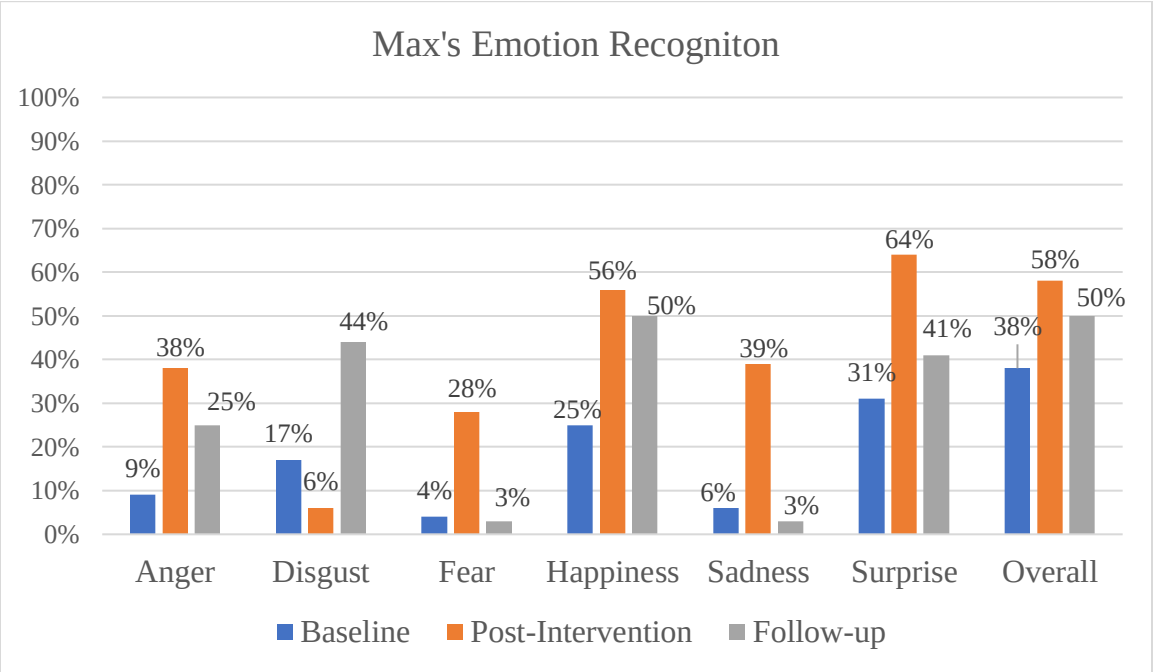

Figure 26. Max's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion Recognition Task (ERT). Max completed the ERT measures for all phases as scheduled. The overall accuracy of emotion recognition increased following the YIC programme (Figure 26) indicating improvement in emotion recognition. The improvement was not maintained at follow-up. Among all the emotions, the accuracy in recognizing anger, fear, happiness, sadness and surprise increased after sleep education. The improvements were not maintained at follow-up.

Max's overall median reaction time to pair a facial expression with an emotion decreased following the Sleep Education programme (0.96 seconds vs. 0.75 seconds). It showed that Max

spent less time in selecting an emotion after a facial expression was presented to him. The increased speed was not maintained at follow-up (0.75 seconds vs. 0.94 seconds).

Overall, Max demonstrated full engagement in the YIC programme. He set a sleep goal but, according to him, he did not achieve it. After sleep education, Max's time in bed on both school nights and non-school nights improved and the improvements were not maintained. Max slept the recommended time for his age on all nights during phase B_1 and B_2. His reported feelings on awakening and feelings during the day were better after sleep education. These improved reports of feelings were not maintained through follow-up. Max's SSR scores decreased, and the improvements were maintained, indicating fewer self-reported sleep problems. Max's working memory accuracy did not improve while strategy improved slightly. The improved strategy score was maintained at follow-up. Both Max's emotion recognition accuracy and speed improved but the improvements were not maintained.

Mia. Mia was fully engaged in the YIC programme (Liberty, 2018) by completing both workbooks. She set a sleep goal, but she reported she did not achieve it. Her sleep goal was "to go to sleep within 20 minutes". Mia told the study researcher during phase B_2 that she was more aware of the sleep facts learned from the YIC programme; and she used them to check her own sleep. For example, she no longer brought her phone and electronic devices to bed. During the entire study, Mia took Melatonin on all school nights to help with her sleep.

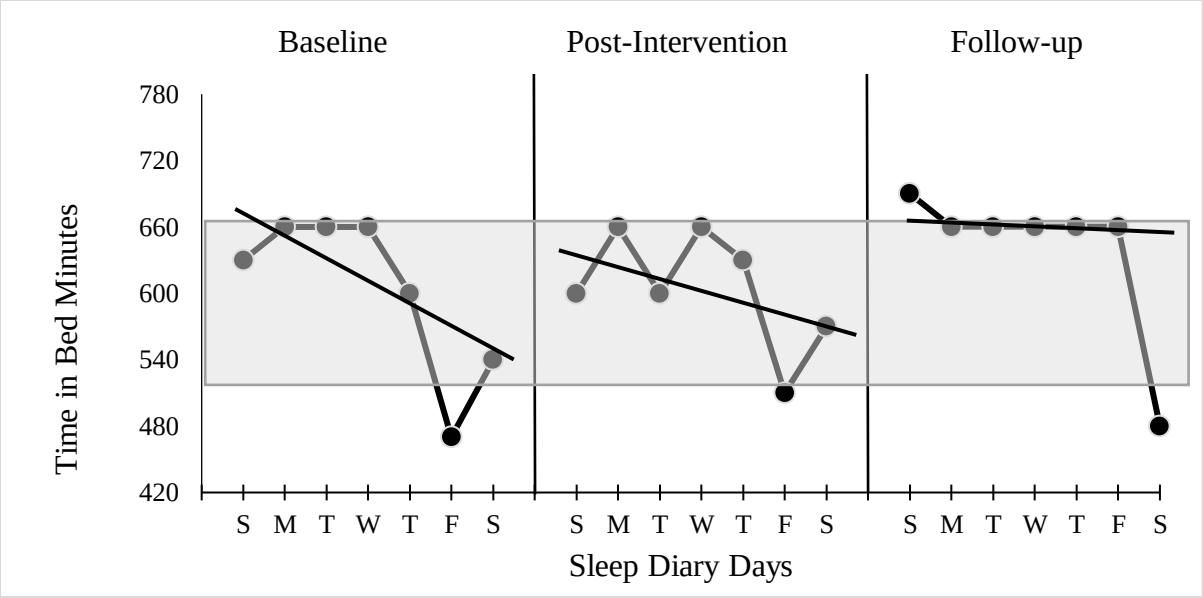

Figure 27. Repeated measures of time in bed in minutes from Mia's self-report sleep diary for each phase, and split-middle trend lines (Cooper et al., 2007).

Note: The shaded area shows the recommended time in bed of 9 to 11 hours for school-aged children between 6 – 13 years (Hirshkowitz et al., 2015).

Repeated Measures.

Time in bed. Mia's time in bed during all phases is presented in Figure 27. Mia's time in bed did not change after sleep education, it improved during the following-up only. She spent the recommended length of time or longer for her age on most nights during all phases.

Trend analysis indicates that Mia's time in bed decreased during the baseline phase. She had the longest time in bed on Monday, Tuesday and Wednesday nights and the shortest time in bed on Friday night. A Similar tread was observed after sleep education, whereas her time in bed decreased during phase B_1. Compared with baseline, Mia spent more time in bed on Thursday, Friday and Saturday after the YIC programme. Trend analysis shows that her time in bed decreased during the follow-up phase. Compared with the previous phase, Mia slept more on Sunday, Tuesday, Thursday, and Friday nights.

Mia's average time in bed during baseline was 602.86 minutes (SD = 73.19). She spent more time in bed on school nights than on non-school nights (Mean = 642, SD = 26.83 vs. Mean = 505, SD = 49.5). During phase B_1, Mia slept for 604.29 minutes on average per night (SD = 53.18), about the same as the average time in bed throughout baseline. On school nights, Mia spent 630 minutes (SD = 30) on average in bed, twelve minutes less per school night compared with the baseline phase. On non-school nights, Mia's average time in bed was 540 minutes (SD = 42.43), 35 minutes more on each non-school night than baseline. Mia spent more time in bed on school nights than non-school nights. She had the longest time in bed on Monday and Wednesday nights and the shortest time in bed on Friday night. During phase B_2, Mia's time in bed on Saturday night was adjusted by taking an hour away due to the start of day-light savings in New Zealand. Mia slept for 638.51 minutes (SD = 70.81) on average per night, 34 minutes more than the previous phase. Her mean time in bed on school nights was 666 minutes (SD = 13.42), 36 minutes more on each school night from the previous phase. On non-school nights, she average time in bed was 570 minutes (SD = 127.28), 30 minutes more than each non-school night from the previous phase. Mia spent more time on school nights than on non-school nights. She had the shortest time in bed on Saturday night and the longest on Sunday night.

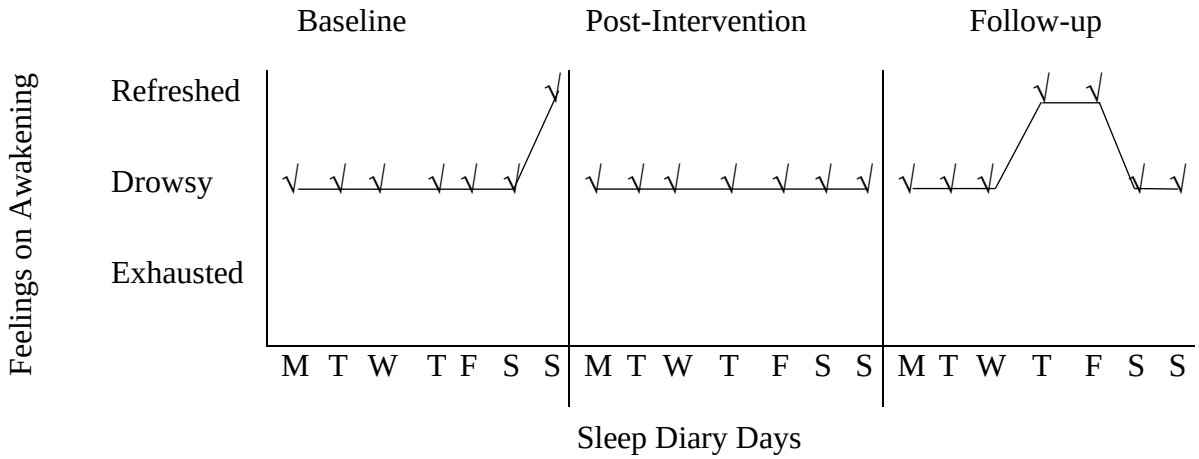

Figure 28. Mia's reported feelings on awakening from Mia's self-report sleep diary for each phase.

Feelings on awakening. Mia's self-reported feelings on awakening for each phase are illustrated by Figure 28. Her reports of feelings on awakening were generally consistent across all phases.

During baseline, she reported waking-up feeling "Drowsy" every morning except for Sunday morning when she felt "Refreshed". Following sleep education, Mia reported feeling "Drowsy" on awakening on all mornings. These were similar to her reports from the previous phase. At follow-up, Mia reported feeling "Refreshed" after waking-up on Thursday and Friday, and she felt "Drowsy" on the other mornings. These were similar to her reports from the previous phase.

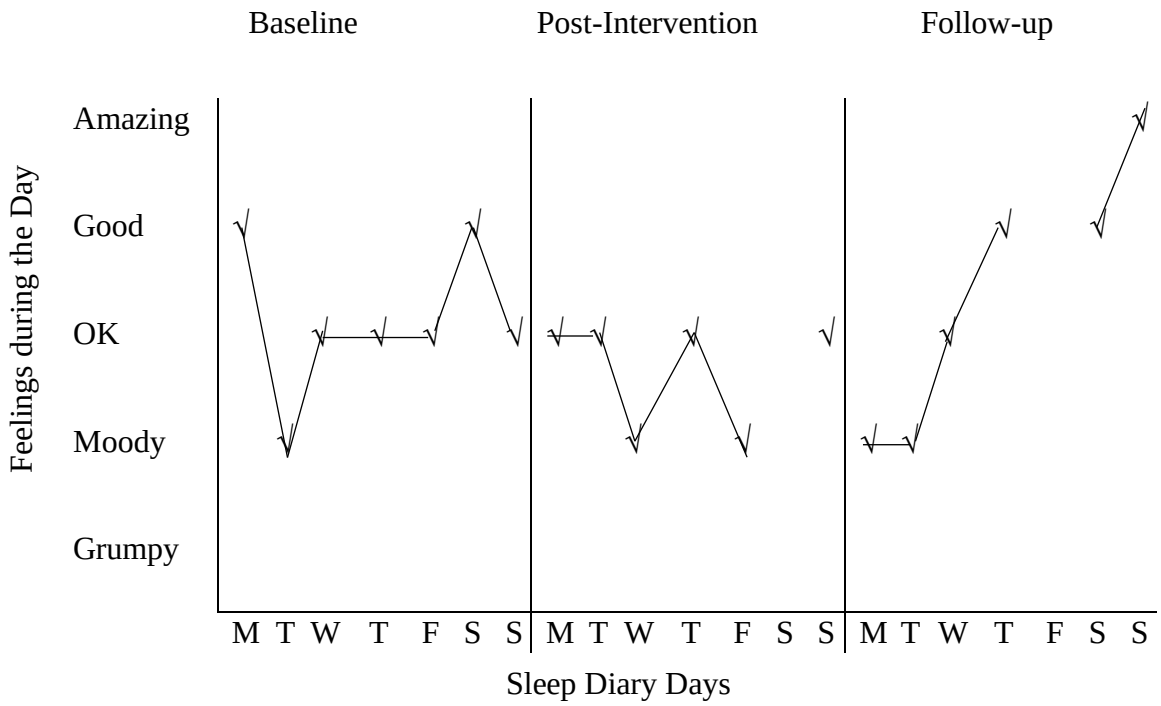

Figure 29. Mia's reported feelings during the day from Mia's self-report sleep diary for each phase.

Feelings during the day. Mia's reported feelings during the day for each phase are illustrated by Figure 29. Her reports during phase B_1 and B_2 were similar to baseline.

During baseline, Mia reported feeling "Good" on Monday and Saturday. She felt "OK" on Wednesday, Thursday, Friday and Sunday. On Tuesday she felt "Moody". During the days following the intervention, Mia reported feeling "OK" on Monday, Tuesday, Thursday and Sunday. She felt "Moody" on Wednesday and Friday. She did not report her feelings on Saturday. These were similar to her reports during baseline. At follow-up, Mia reported feeling "Amazing" on Sunday, "Good" on Thursday and Saturday, "OK" on Wednesday, "Moody" on Monday and Tuesday. She did not record how she felt on Friday. These were similar to her reports during the previous phase.

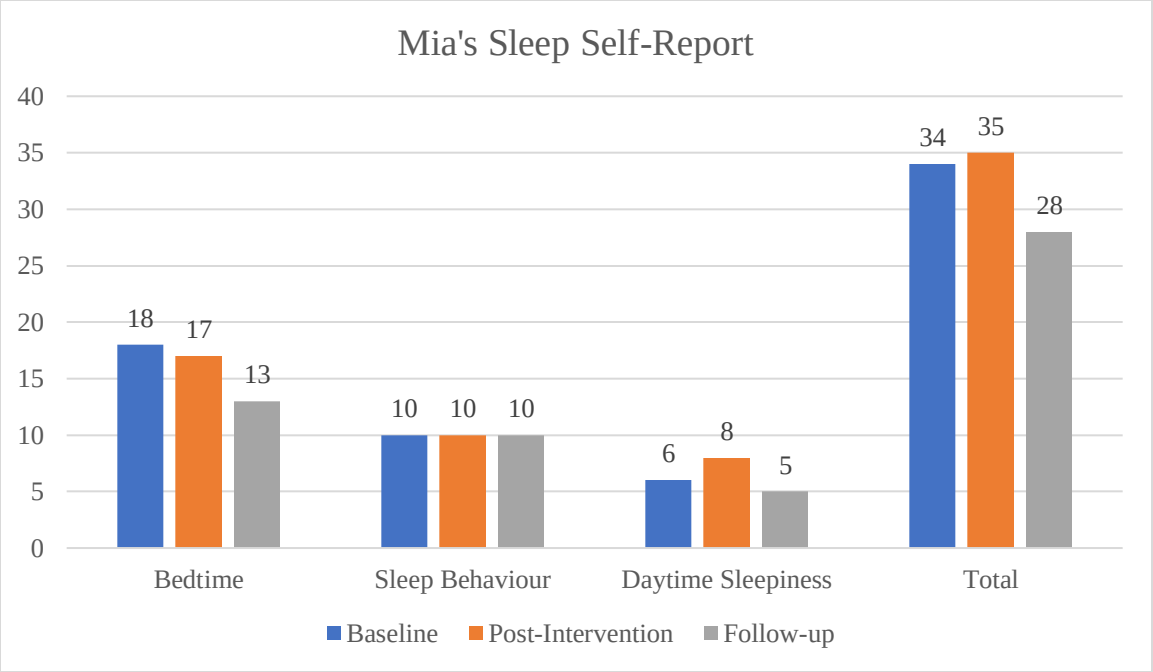

Figure 30. Mia's Sleep Self-report scores. Higher scores indicate more problems.

Sleep-Self Report (SSR). Mia completed the SSR questionnaire for all phases as scheduled. The SSR scores are illustrated by Figure 30. Mia's SSR total score at phase B1 was similar to her score at phase A; however, it decreased at phase B2, indicating fewer self-reported sleep problems at follow-up.

Mia's SSR Total score was slightly higher following sleep education as compared with baseline. This was resulted from the increased number of reported sleep problems on daytime sleepiness subscale. Mia reported more often "having trouble waking up in the morning", and "feel sleepy during the day". The SSR Bedtime subscale score decreased slightly, this was resulted from changes on a few item ratings. For example, items Mia rated suggesting improvement in sleep problems were "Do you fight with your parents about going to bed", "Is it hard for you to go to be" and "Are you afraid of the dark". Whereas items Mia reported feeling worse about were "Do you go to bed at the same time every night on school nights", and "Are

you ready for bed at your usual bedtime". The SSR Sleep Behaviour subscale scores at phase A and phase B_1 remained unchanged and item ratings were consistent. At follow-up, the SSR Bedtime score and the SSR Daytime Sleepiness score decreased, indicating an improvement in reported sleep problems at follow-up. Items Mia rated improvement in sleep problems were "Do you have a special thing you bring to bed", "Are you afraid of the dark", and "Do you feel rested after a night's sleep".

Mia's mother set bedtime sleep rules for her at phase A. At phase B_1, Mia and her mother set sleep rules together. At phase B_2, Mia's mother set sleep rules for her. She reported having trouble sleeping at phase A and phase B_1, and sometimes having trouble sleeping at phase B_2. Mia did not like to go to sleep at all phases.

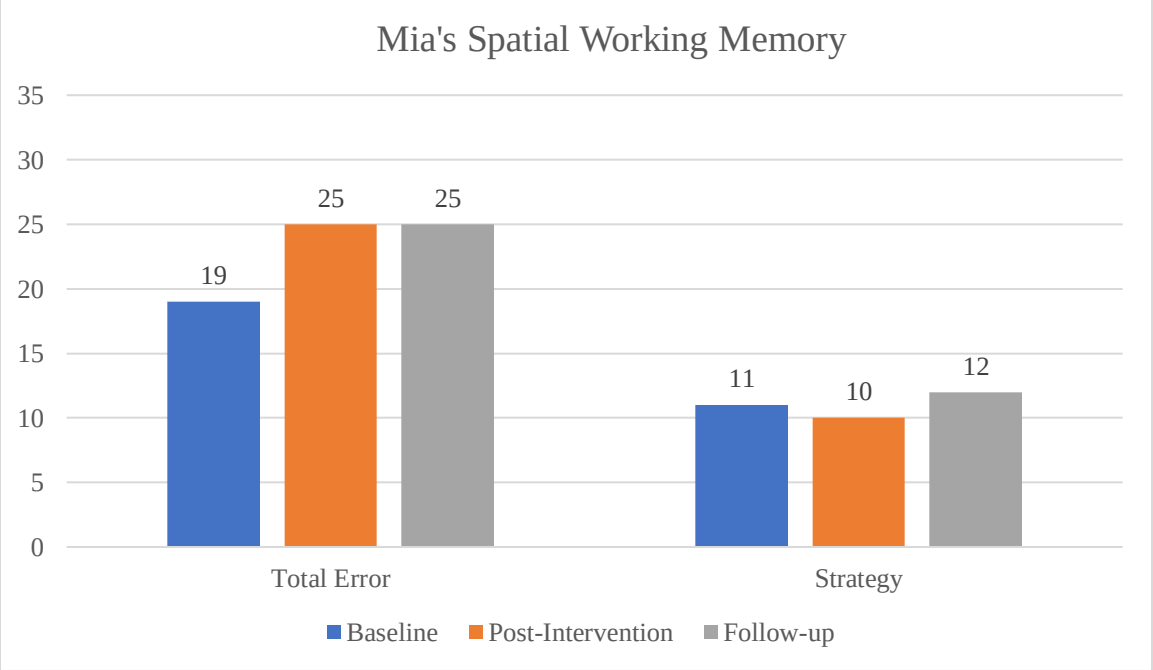

Figure 31. Mia's Spatial Working Memory Task scores. Lower scores indicate fewer errors, and improved strategy.

Spatial Working Memory (SWM). Mia completed the SWM measures for all phases as scheduled. Mia's total error score increased following the YIC programme and the increased

score was maintained at follow-up (Figure 31), indicating no improvement in working memory accuracy. Mia's strategy score decreased by one point after sleep education indicated a slight improvement in working memory strategy. The improvement was not maintained at follow-up.

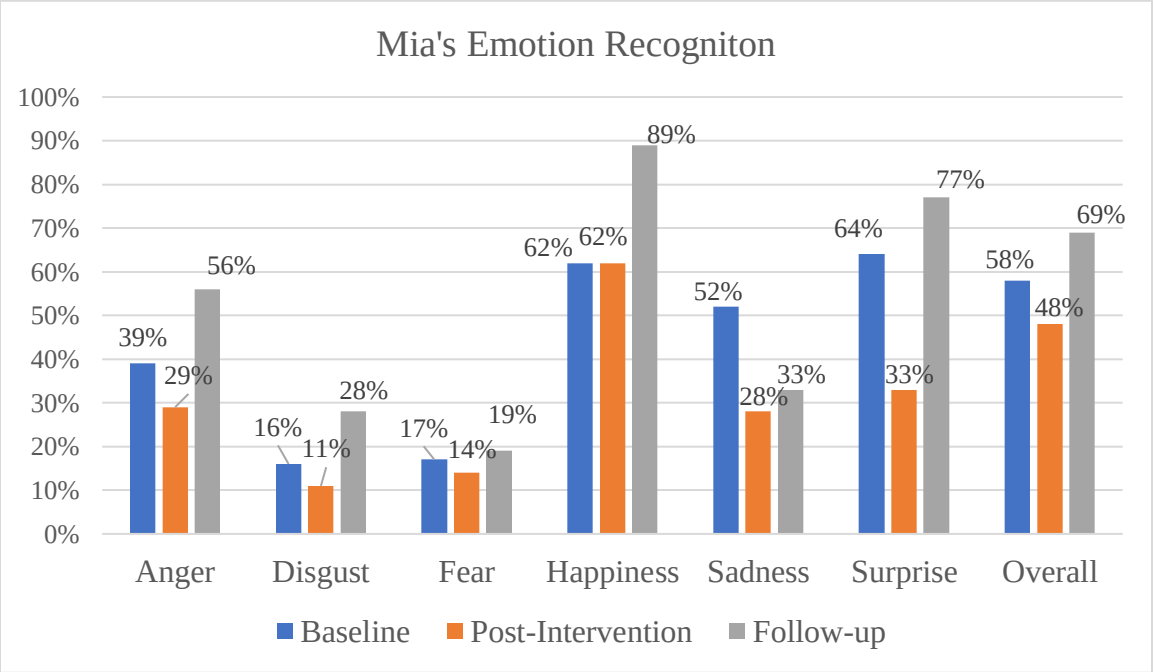

Figure 32. Mia's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion Recognition Task (ERT). Mia completed the ERT measures for all phases as scheduled. As shown by figure 32, the overall accuracy of emotion recognition decreased following the YIC programme (Liberty, 2018). However, the accuracy of emotion recognition increased at follow-up indicating improvement in emotion recognition at follow-up.

Mia's overall median reaction time to pair a facial expression with an emotion increased slightly over time (A: 1.03 seconds; B_1: 1.12 seconds; B_2: 1.2 seconds). It showed that Mia spent about the same amount of time or more selecting an emotion after a facial expression was presented to her.

Overall, Mia was fully engaged in the YIC programme (Liberty, 2018). She set a sleep goal but did not achieve it. After sleep education, Mia's time in bed on school nights decreased yet time in bed on non-school days increased. During follow-up, time in bed on both school nights and non-school nights improved. Mia slept the recommended time or more on school nights during all phases. Mia's reported feelings on awakening and feelings during the day did not change across phases. Mia reported fewer sleep problems at follow-up. Her working memory accuracy did not change while strategy improved after sleep education, which was not maintained at follow-up. Mia's emotion recognition accuracy improved at follow-up. No improvement in speed was shown.

Edward. Edward achieved full engagement in the YIC programme (Liberty, 2018) by completing both workbooks. Edward's sleep goal was "not waking up too early". The goal was reported as accomplished. According to Edward's sleep diaries, Edward's average wake-up time during the post-intervention phase B_1 was 24 minutes later than the average wake-up time during the baseline phase A (Mean = 6:45 am, SD = 0:34; vs. Mean = 6:22 am, SD = 0:34). During phase B_2, his average wake-up time was 7:04 am (SD = 1.12). This supports Edward's report that he accomplished his goal. The diaries also indicate that this improvement was maintained during phase B_2.

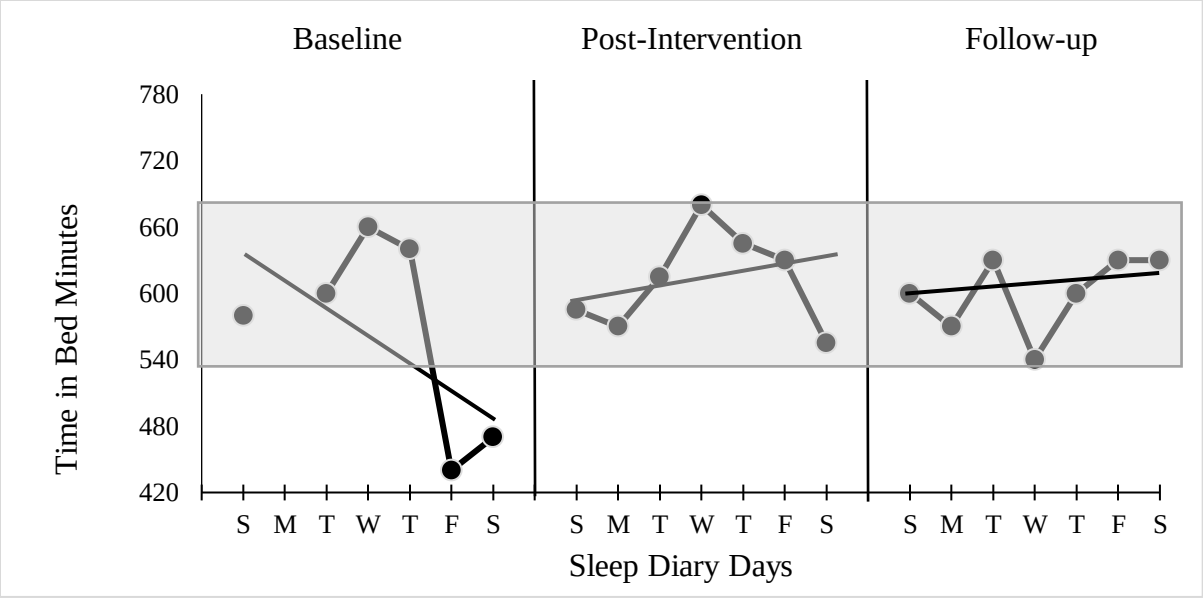

Figure 33. Repeated measures of time in bed in minutes from Edward's self-report sleep diary for each phase, and split-middle trend lines (Cooper et al., 2007).

Note: The shaded area shows the recommended time in bed of 9 to 11 hours for school-aged children between 6 - 13 years (Hirshkowitz et al., 2015).

Repeated Measures. Edward completed the sleep diaries for phase B_1 during the first week of school term three, instead of the schedule week, which was the last week of term two.

Time in bed. Edward's time in bed during all phases is presented in Figure 33. There was an improvement in Edward's time in bed from phase A to B_1, and this was stable though B_2. Edward's time in bed appeared more consistent after sleep education and during follow-up. Comparing Edward's time in bed with that recommended for the age group, Edward spent the recommended length of time or longer in bed on every night during phase B_1 and B_2, which was an improvement from phase A.

Trend analysis indicates that Edward's time in bed decreased during phase A. Trend analysis indicates that Edward's time in bed increased during phase B_1. During phase B_1, Edward spent the least amount of time in bed on Saturday night, and the most amount of time on Wednesday night. Trend analysis indicates that his time in bed increased during phase B_2. He

spent the least amount of time in bed on Wednesday night, where he shared a bedroom with siblings, and the most amount of time on Tuesday, Friday and Saturday nights. Edward spent more time in bed on weekend nights than on school nights.

During the baseline phase A, where data was not available on Monday night, Edward's average time in bed was 565 minutes (SD = 90.28). He spent more time in bed on school nights than on non-school nights (Mean = 620, SD = 36.51; vs. Mean = 455, SD = 21.21). He spent the least amount of time in bed on Friday night where he shared a bedroom with siblings at one parents' house. He spent the most amount of time in bed on Wednesday night. During phase B_1, Edward spent 611.43 minutes on average (SD = 44.32) in bed, which was 46.43 minutes more than his average time in bed during the baseline phase A. The average time in bed on school nights was about the same as phase A (Mean = 619, SD = 44.64; vs. Mean = 620, SD = 36.51). Edward stayed in bed for 592.5 minutes (SD = 53.0) on average on non-school nights, which was about 137 minutes more than each non-school night during phase A. On average, Edward spent more time in bed on school nights than non-school nights. Edward spent more time in bed on each night during phase B_1 than during phase A except for Monday, where comparison was not available. During the follow-up phase B_2, Edward's time in bed on Saturday night was adjusted by taking an hour away due to the start of day-light savings in New Zealand. The mean time in bed during phase B_2 was 600 minutes (SD = 34.64), 11.43 minutes less on an average night than the mean time in bed of the previous phase. Edward's mean time in bed on school nights was 588 minutes (SD = 34.21), which indicated that Edward spent 31 minutes less in bed on average per school night than the previous phase. Edward's average time in bed on non-school nights was 630 minutes (SD = 0), which was 37.5 minutes more per non-school night as compared with phase B_1.

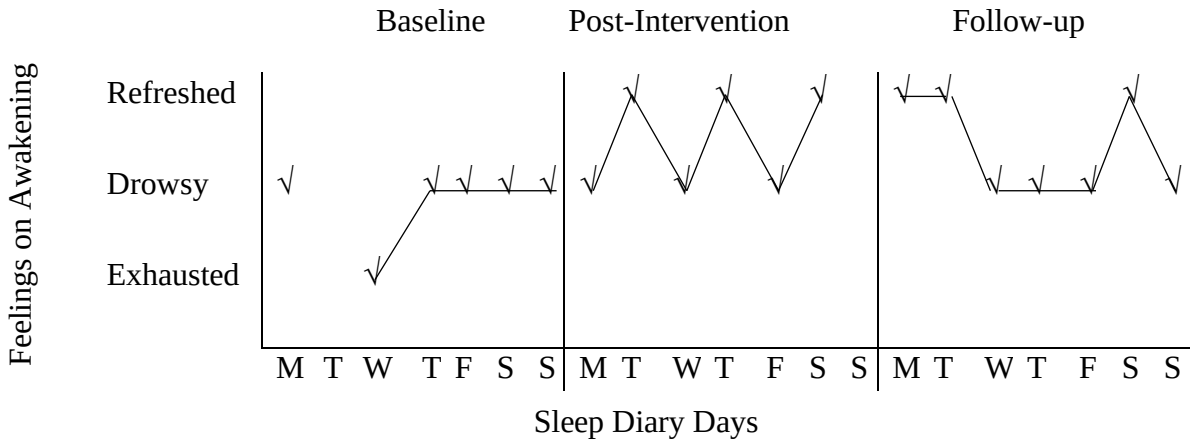

Figure 34. Edward's reported feelings on awakening from Edward's self-report sleep diary for each phase.

Feelings on awakening. Edward's reported feelings on awakening for each phase are illustrated by Figure 34. There was an improvement in Edward's feelings on awakening from phase A to B_1, and the improvement was maintained at follow-up.

At baseline phase A, where data on Tuesday morning was not available, Edward reported waking-up feeling "Drowsy" on all mornings except for Wednesday, where he felt "Exhausted". He wrote in the note section that he found it hard to sleep on Tuesday, Friday, Saturday and Sunday nights where he shared a bedroom with other siblings at one parent's house. Compared with baseline, his reported feelings on awakening improved after sleep education. During the post-intervention phase B_1, Edward reported feeling "Refreshed" when waking up on Tuesday, Thursday and Saturday mornings. He felt "Drowsy" on Monday, Wednesday and Friday, when waking up at the other parent's house. At follow-up, Edward reported feeling "Refreshed" on Monday, Tuesday and Saturday mornings, "Drowsy" on Wednesday, Thursday, Friday and Sunday mornings. It showed that the improvement of positive feelings were maintained during follow-up.

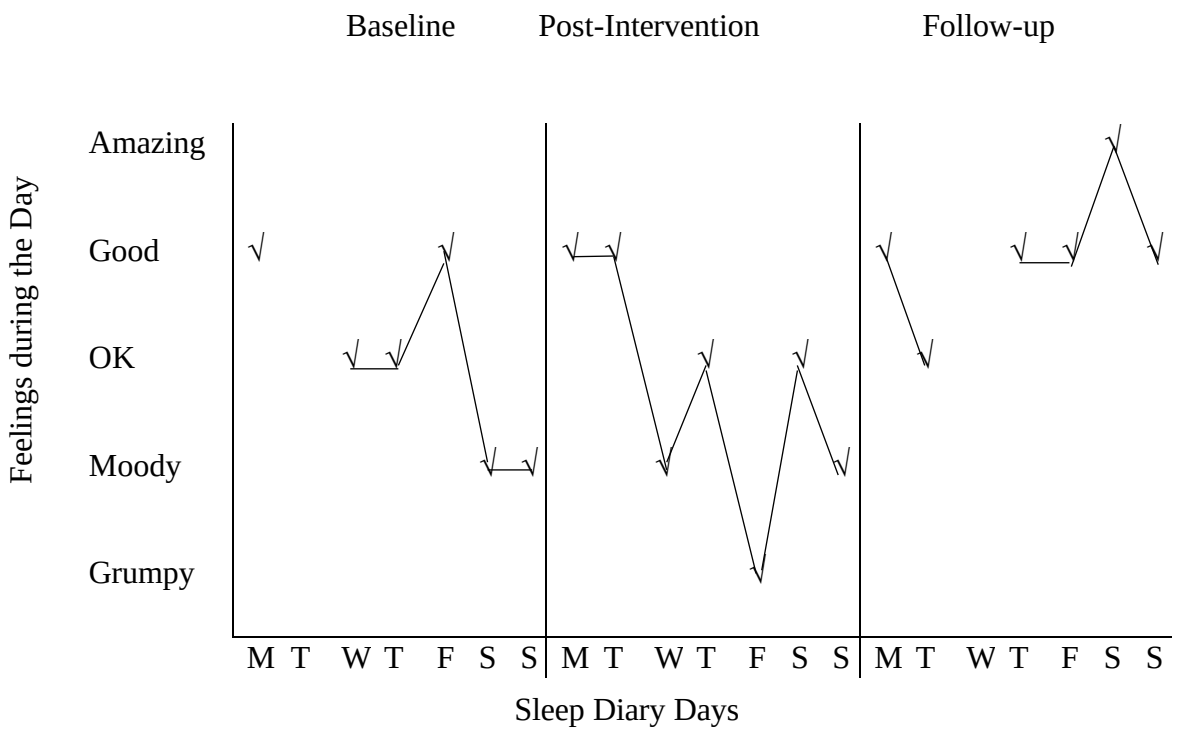

Figure 35. Edward's reported feelings during the day from Edward's self-report sleep diary for each phase.

Feelings during the day. Edward's self-reported feelings during the day for each phase are illustrated in Figure 35. Edward's reported daytime feelings after sleep education were similar to his reports during baseline; however, improved daytime feelings were observed during follow-up.

During baseline, when data on Tuesday was not available, Edward reported feeling "Good" on Monday and Friday, feeling "OK" on Wednesday and Thursday. He reported feeling "Moody" on both weekend days. Post-intervention, Edward reported feeling "Good" on Monday and Tuesday, "OK" on Thursday and Saturday, "Moody" on Wednesday and Sunday, and "Grumpy" on Friday. These did not change compared to the previous phase. Through follow-up, Edward reported feeling "Amazing" on Saturday, "Good" on Monday, Thursday, Friday and

Sunday, and "OK" on Tuesday. He did not provide data for Wednesday. These are generally better than his reports during the previous phases.

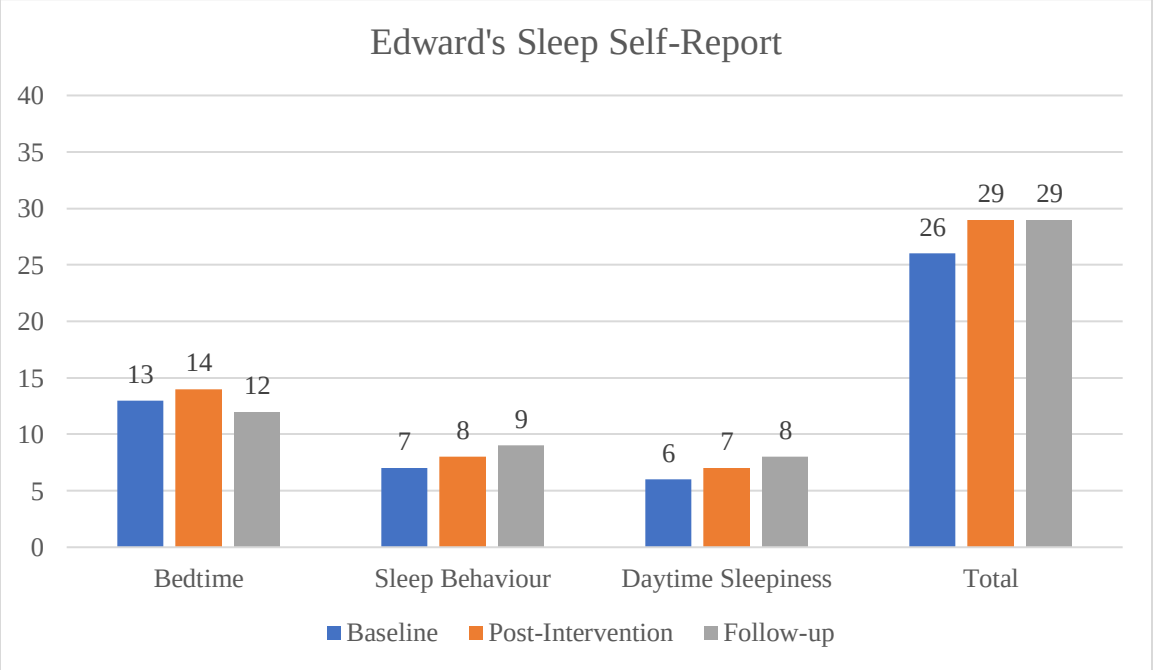

Figure 36. Edward's Sleep Self-report scores. Higher scores indicate more problems.

Sleep-Self Report (SSR). Edward completed the SSR questionnaire for all phases as scheduled. His SSR scores are illustrated by Figure 36. Edward's SSR Bedtime, SSR Sleep Behaviour, SSR Daytime Sleepiness and SSR Total scores increased at the post-intervention phase B_1 as compared with the baseline phase A, indicating that he reported more sleep problems. His reports did not change at follow-up.

The items Edward rated as more problematic were: "Do you fight with your parents about going to bed", "Do you have trouble falling back to sleep if you wake up during the night", and "Do you have trouble waking up in the morning". At the follow-up phase B_2, the increased number of problems was maintained with the exception of SSR Bedtime score. Edward reported fewer problems at bedtime at phase B_2 as he reported more consistent bedtime on school nights.

Both of Edward's parents set bedtime sleep rules for him at all three phases. He reported having trouble sleeping at phase A, not having trouble sleeping at phase B_1 and having trouble sleeping again at phase B_2. Edward liked to go to sleep at all phases.

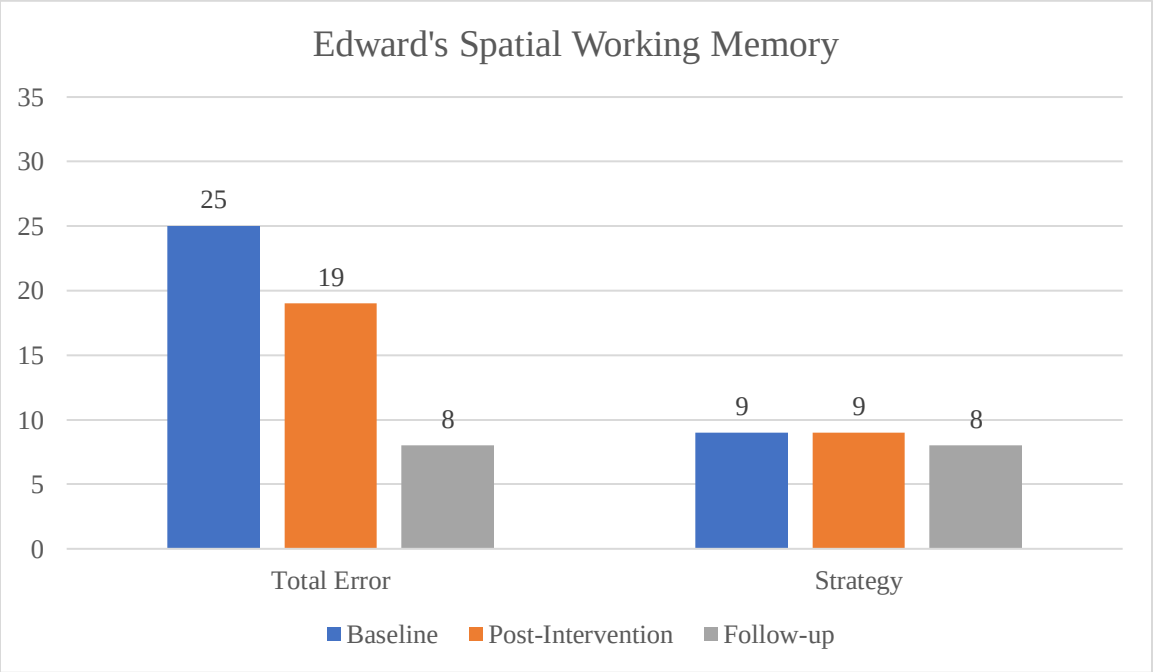

Figure 37. Edward's Spatial Working Memory Task scores. Lower scores indicate fewer errors and improved strategy.

Spatial Working Memory (SWM). Edward completed the SWM measures of all phases as scheduled. Edward's total error score decreased at the post-intervention phase B_1 and continued to improve at the follow-up phase B_2 (Figure 37), indicating an overall improvement in working memory accuracy. Edward's strategy score did not change at phase B_1 and decreased by one point at phase B_2, indicating a slight improvement in working memory strategy at follow-up.

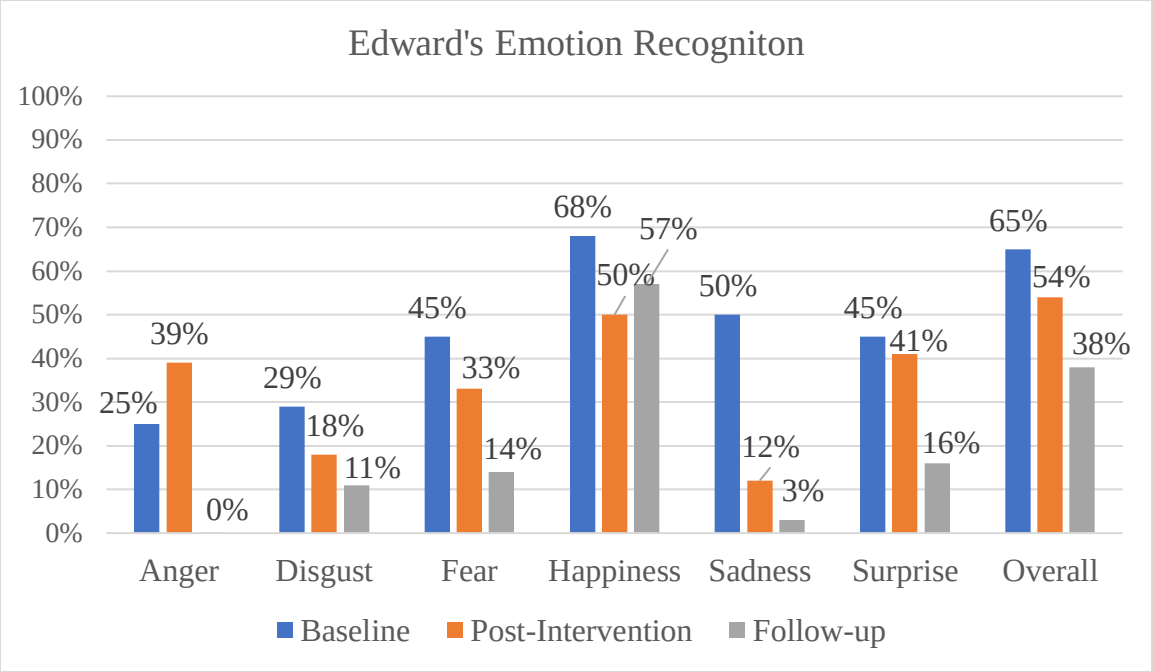

Figure 38. Edward's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion Recognition Task (ERT). Edward completed the ERT measures for all phases as scheduled. His overall accuracy of emotion recognition decreased at the post-intervention phase B_1 and continued to decrease at the follow-up phase B_2 (Figure 38), indicating a decline in emotion recognition accuracy. Among all the emotions, the accuracy of recognizing anger increased at phase B_1, but the improvement was not maintained at phase B_2.

Edward's overall median reaction time to pair a facial expression with an emotion decreased from 1.33 seconds at phase A to1.09 seconds at phase B_1, and it further decreased to 0.74 seconds at phase B_2. It showed that Edward spent less time in selecting an emotion after a facial expression was presented to him, which might explain the overall decline in accuracy.

Overall, Edward was fully engaged in the programme and achieved his sleep goal. After sleep education, Edward's time in bed improved, and his time in bed appeared to be more consistent across nights. The increased time in bed was not maintained during follow-up. Edward spent the recommended time or more for his age group on every night including non-school nights after sleep education. This was maintained during follow-up. After sleep education, Edward reported feeling refreshed on more mornings, and the improvement was maintained during follow-up. His reported feelings during the day did not change after sleep education, yet it improved during follow-up, where he reported all positive feelings. Edward reported more sleep problems on the SSR questionnaire after sleep education. This did not change at follow-up. His working memory accuracy improved, and the improvement in accuracy was maintained. His working memory strategy improved by one point at follow-up only. Edward's emotion recognition accuracy did not improve after sleep education, yet he was quicker at pairing facial expressions with emotions.

Ethan. Ethan was fully engaged in the YIC programme (Liberty, 2018). He completed both workbooks. He set a sleep goal, which was to "stay asleep the whole night". He reported the goal was achieved after sleep education. Ethan reported the goal achievement was not maintained during follow-up.

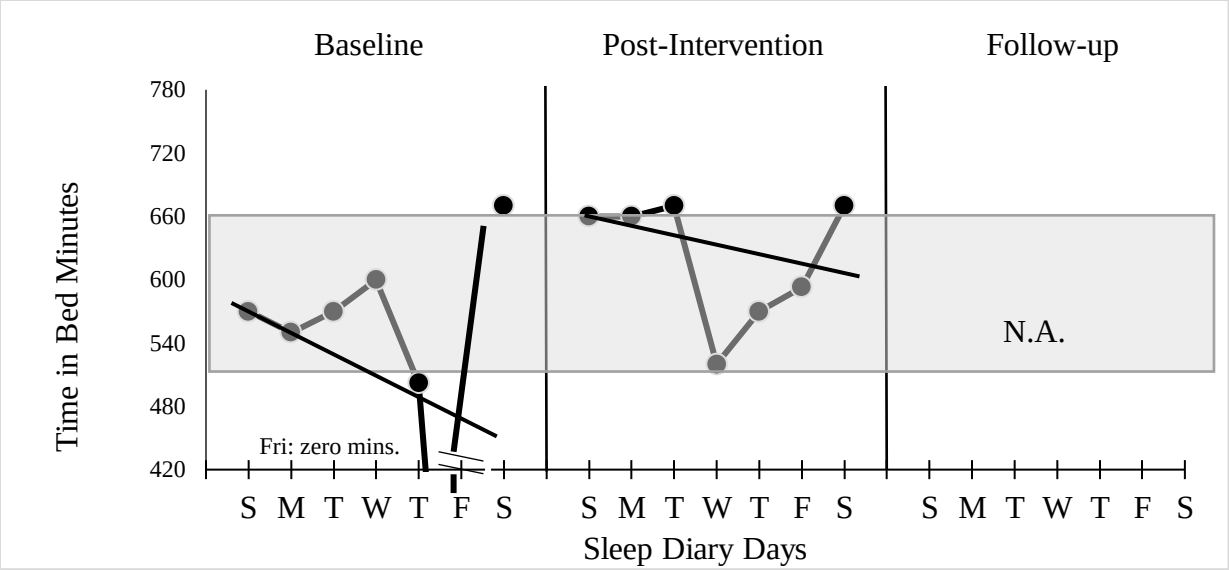

Figure 39. Repeated measures of time in bed in minutes from Ethan's self-report sleep diary for each phase, and split-middle trend lines (Cooper et al., 2007).

Note: The shaded area shows the recommended time in bed of 9 to 11 hours for school-aged children between 6 – 13 years (Hirshkowitz et al., 2015).

Repeated Measures. Ethan completed the baseline sleep diaries during the second week of term two, one week later than the scheduled baseline phase A. Sleep diaries for the post-intervention phase B_1 were completed during the first week of term three instead of the last week of term two, with a two-week school break in between. He did not complete the sleep diaries during the follow-up phase B_2.

Time in bed. Ethan's time in bed during the baseline phase A and during the post-intervention phase B_1 is presented in Figure 39. After sleep education, Ethan's time in bed not only improved but became more consistent across nights. Ethan spent the recommended time in bed every night after sleep education, which was an improvement from baseline.

Trend analysis indicates that Ethan's time in bed decreased during phase A. Comparing Ethan's time in bed with that recommended for the age group, Ethan spent the recommended length of time or longer in bed except for Thursday and Friday nights during baseline. Trend

analysis indicates that Ethan's time in bed immediately increased, but they decreased during phase B_1. He spent the least amount of time in bed on Wednesday night and the most amount of time in bed on Tuesday and Saturday night. He stayed in bed longer on non-school nights than on school nights. Compared with phase A, Ethan spent more time in bed on each night during phase B_1 except for Wednesday. He spent the recommended length of time or longer for his age on all nights during phase B_1.

During phase A, Ethan's mean time in bed was 494.57 minutes (SD = 223.98). He stayed in bed longer on school nights than on weekend nights (Mean = 558.4 minutes, SD = 36.23 vs. Mean = 335 minutes, SD = 473.76). He reported zero minute of sleep on Friday night when he stayed up all night for no particular reasons. He spent the most amount of time in bed on Saturday night. During the post-intervention phase B_1, Ethan spent on average 620.45 minutes in bed (SD = 59.71) per night, which was about two hours more than his average time in bed during the baseline phase A. Ethan stayed in bed for 616 minutes (SD = 67.31) on average per school night during phase B_1, which was nearly an hour more on every school night than phase A. Ethan stayed in bed for an average of 631.5 minutes (SD = 54.45) on non-school nights, which was about five hours more per night than phase A. The difference was due to Ethan staying up all night on the Friday night of phase A.

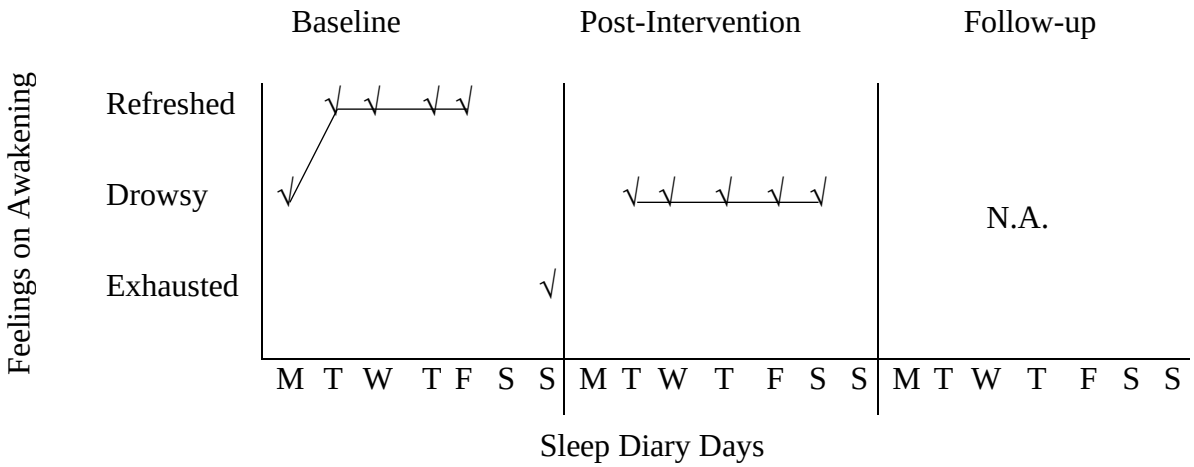

Figure 40. Ethan's reported feelings on awakening from Ethan's self-report sleep diary for each phase.

Feelings on awakening. Ethan's reported feelings on awakening during the baseline phase A and during the post-intervention phase B_1 are illustrated by Figure 40. His feelings on awakening decreased following the YIC programme.

During phase A, Ethan reported waking-up feeling "Refreshed" on Tuesday, Wednesday, Thursday and Friday. He felt "Drowsy" on Monday morning and "Exhausted" on Sunday morning. No data was available for Saturday morning. In the post-intervention phase, Ethan reported feeling "Drowsy" on Tuesday, Wednesday, Thursday, Friday and Saturday mornings. These were worse than his reports during baseline. Data was not available for Sunday and Monday nights.

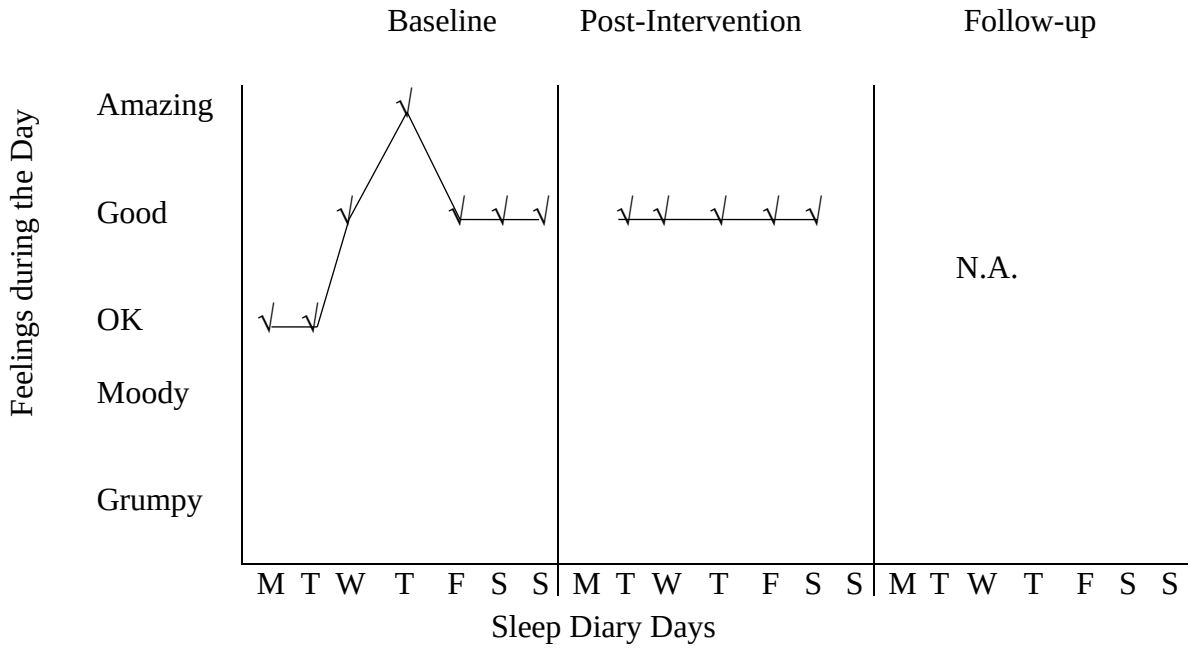

Figure 41. Ethan's reported feelings during the day from Ethan's self-report sleep diary for each phase.

Feelings during the day. Ethan's self-reported feelings during the day for phase A and phase B_1 are illustrated by Figure 41. His reports during phase B1 were similar to phase A.

During phase A, Ethan reported feeling "Amazing" on Thursday, feeling "Good" on Wednesday, Friday, Saturday and Sunday. he felt "OK" on the other two days. During Phase B_1, Ethan reported feeling "Good" during the day on Tuesday, Wednesday, Thursday, Friday and Saturday. No data were available for Sunday and Monday. These positive reports were similar to his reports during baseline.

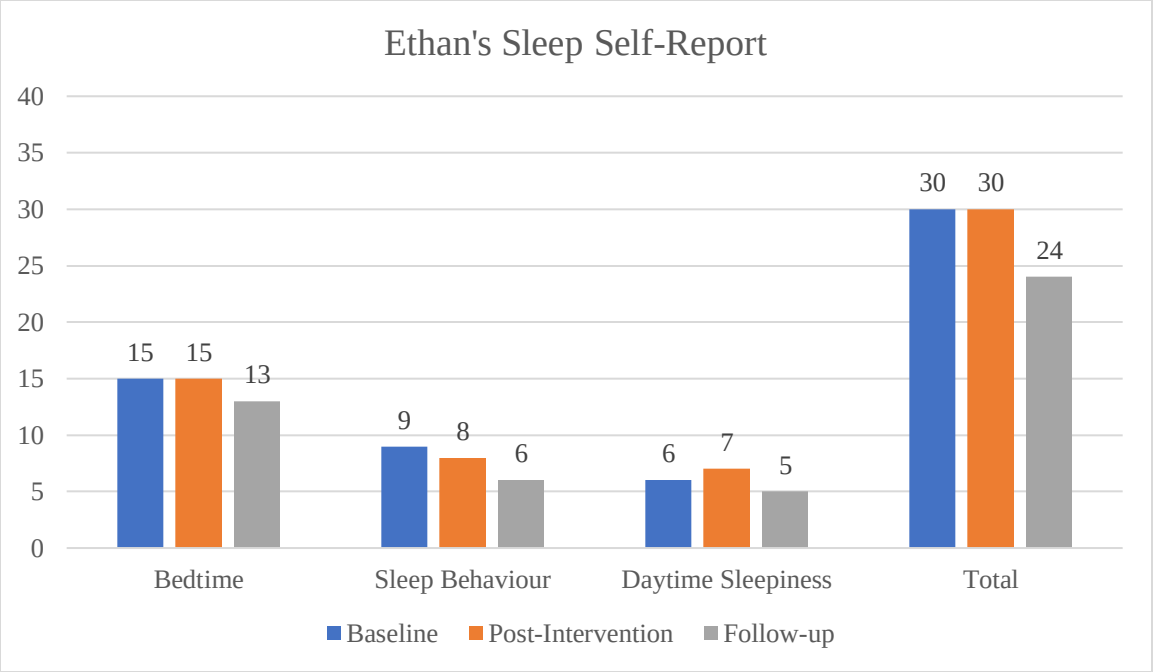

Figure 42. Ethan's Sleep Self-report scores. Higher scores indicate more problems.

Sleep-Self Report (SSR). Ethan completed the SSR questionnaire for all phases as scheduled. His SSR scores are illustrated by Figure 42. Ethan's SSR total scores at phase B_1 and phase A were the same, indicating no change in reported sleep problems. However, Ethan reported fewer sleep problems at follow-up, as shown by a reduction in SSR total score.

Ethan's SSR Bedtime, SSR Sleep Behaviour, SSR Daytime Sleepiness and SSR total scores at the baseline phase A were about the same with the ones at the post-intervention phase B_1, however, there were some variations in specific items. Items Ethan rated as showing reductions in sleep problems were "Do you fight with your parents about going to bed", "Do you think you sleep too little", "Do you have trouble falling back to sleep if you wake up during the night". New problems or increased problems were "Do you stay up late when your parents think you are asleep", "Do you wake up at night when your parents think you are asleep", and "Do you feel rested after a night's sleep". At the follow-up phase B_2, all SSR subscale scores decreased, and the total score decreased, indicating an overall reduction in sleep problems. Items Ethan

rated showing improvement were “Do you go to bed at the same time every night on school nights”, “Do you fall asleep in about 20 minutes”, “Do you fight with your parents about going to bed”, “Do you think you sleep too little”, and “Do you feel rested after a nights’ sleep”.

Ethan’s mother set bedtime sleep rules for him at all three phases. He reported having trouble sleeping at phase A, sometimes having trouble sleeping at phase B_1, and having no trouble sleeping at phase B_2. Ethan did not like to go to sleep at baseline but liked to go to sleep sometime at phase B_1 and phase B_2.

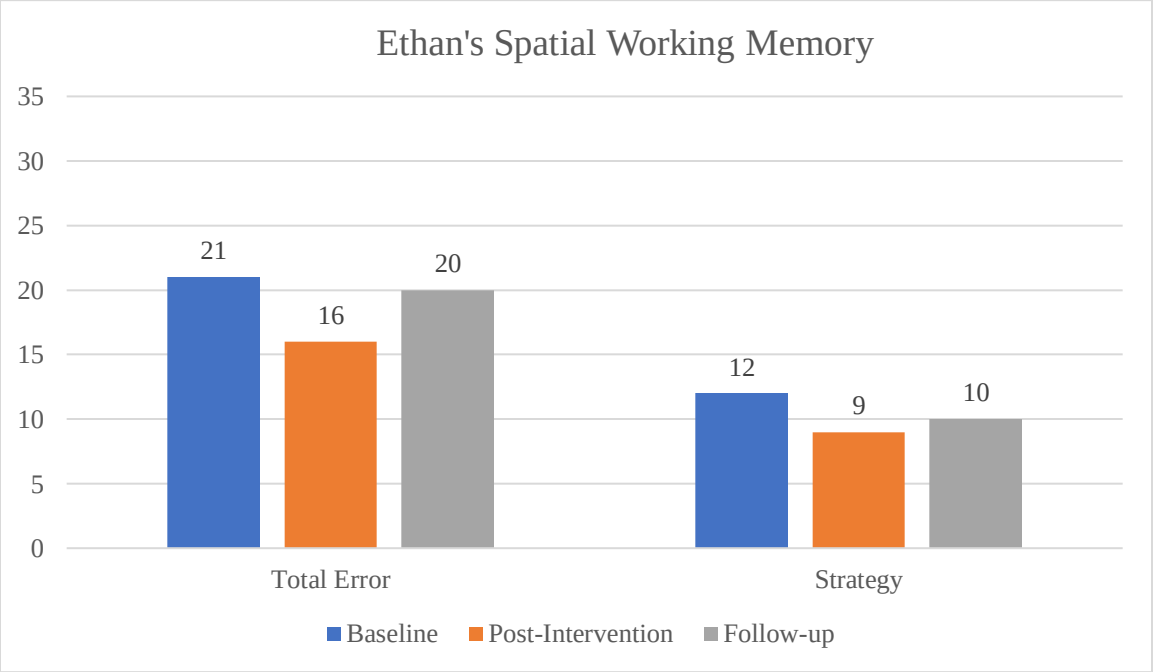

Figure 43. Ethan’s Spatial Working Memory Task scores. Lower scores indicate fewer errors, and improved strategy.

Spatial Working Memory (SWM). Ethan completed the SWM measures for all phases as scheduled. Ethan’s total error score decreased at the post-intervention phase B_1, indicating improvement in working memory accuracy (Figure 43). The improvement was not maintained at the follow-up phase B_2. Ethan’s strategy score decreased at phase B_1. It shows that Ethan

applied a better-planned search strategy after sleep education. The improvement was not maintained at phase B_2.

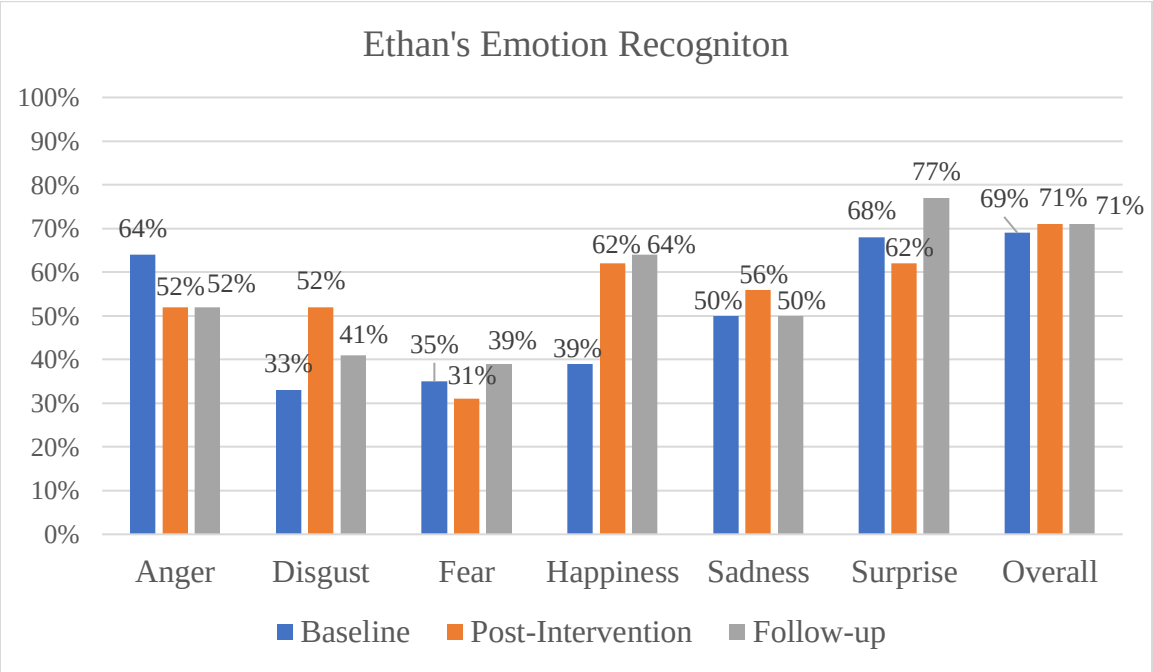

Figure 44. Ethan's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion Recognition Task (ERT). Ethan completed the ERT measures for all phases as scheduled. The overall accuracy of emotion recognition increased slightly at the post-intervention phase B_1 and this improvement was maintained at the follow-up phase B_2 (Figure 44), indicating improvement in overall emotion recognition accuracy. Among all the emotions, the accuracy of recognizing disgust, happiness and sadness improved at phase B_1, and the improvements were maintained at phase B_2, except for sadness.

Ethan's overall median reaction time to pair a facial expression with an emotion increased at phase B_1 (phase A = 1.34 seconds vs. phase B_1 = 1.57 seconds). It showed that Ethan spent more time in selecting an emotion after a facial expression was presented to him.

The median reaction time at phase B_2 was similar to Ethan's reaction time at phase B_1 (1.49 seconds), showing no improvement in emotion recognition speed.

Overall, Ethan showed full engagement in the programme and achieved his sleep goal. After sleep education, Ethan's time in bed on both school nights and non-school nights improved. His time in bed across the week appeared to be more consistent as indicated by trend lines (Figure 39), and he spent the recommended time or more in bed for his age group every night during phase B_1. His feelings on awakening did not improve, yet his reports of positive feelings during the day were consistent during both phases. Ethan did not complete sleep diaries for the follow-up phase B_2, although he did complete the SSR questionnaire and the cognitive tests. Ethan's SSR scores decreased at follow-up indicating a delayed improvement in self-reported sleep problems. Ethan's working memory accuracy and working memory strategy both improved after sleep education. These were not maintained at follow-up. Ethan's emotion recognition accuracy improved slightly, and the improvement was maintained. His emotion recognition speed did not improve.

Emma. Emma was fully engaged in the YIC programme (Liberty, 2018). Both workbooks were completed. Her sleep goal was "go to sleep and wake-up at the same time every day". The goal was reported accomplished, and the achievement was maintained. This was further confirmed when looking at Emma's bedtimes and wake-up times from her sleep dairies of all phases. Conversation with Emma following the intervention, revealed Emma made rearrangements to her room in order to avoid light exposure from the hallway at night so that she can sleep better. She reported falling asleep easier and sleeping longer in the morning. After sleep education, Emma went to bed at 8:30 pm every night. Emma noted that she read in bed for

30 minutes every night before sleep. She woke-up around 8 am every morning unless engaged in a family event that disrupted her routine.

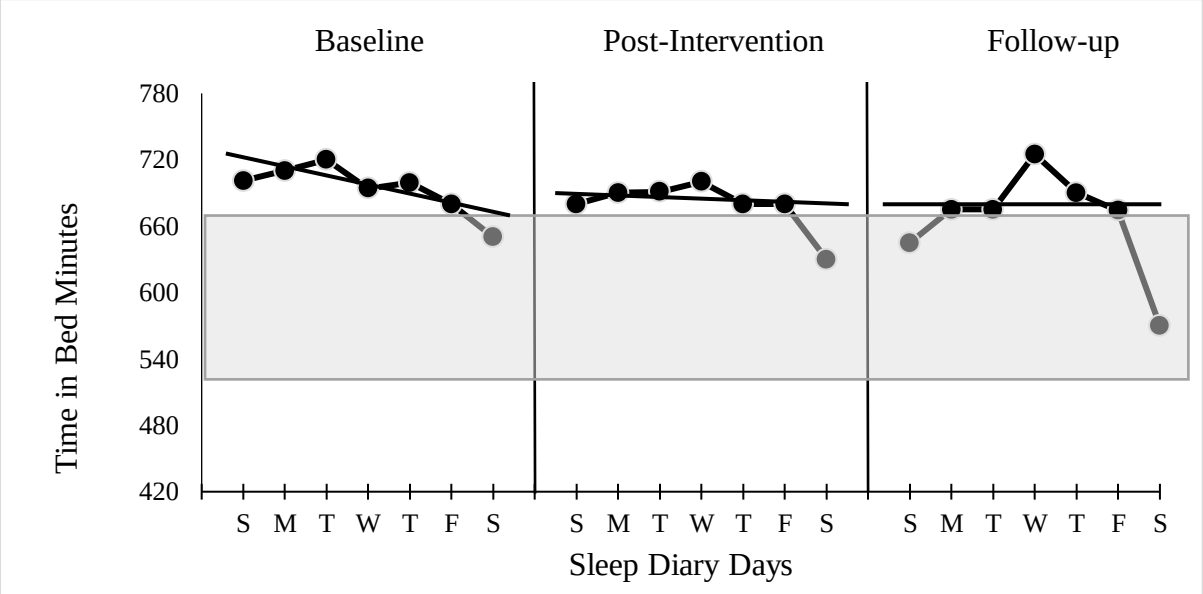

Figure 45. Repeated measures of time in bed in minutes from Emma's self-report sleep diary for each phase, and split-middle trend lines (Cooper et al., 2007).

Note: The shaded area shows the recommended time in bed of 9 to 11 hours for school-aged children between 6 – 13 years (Hirshkowitz et al., 2015).

Repeated Measures.

Time in bed. Emma's time in bed during all phases is presented in Figure 45. Her time in bed decreased following the sleep education and further decreased during follow-up. However, Emma spent the recommended length of time or longer in bed on all nights during all phases.

Trend analysis indicates that Emma time in bed decreased during the baseline phase and was stabilized after sleep education, which matches with the goal she set. Trend analysis shows that her time in bed was stable during the follow-up phase, showing that the goal was maintained.

Her average time in bed during baseline was 693.43 minutes (SD = 22.86). She slept longer on school nights than on non-school nights (Mean = 704.8, SD = 10.28, vs. Mean = 665, SD = 21.21). Her longest night was Tuesday night, and the shortest night was Saturday night. During phase B_1, Emma slept for 678.71 minutes on average per night (SD = 22.77), which was fifteen minutes less than the average time in bed at baseline. On school nights, Emma slept for 688.2 minutes (SD = 8.44) on average per night, which was about sixteen minutes less per school night compared with the baseline phase. On non-school nights, Emma's average time in bed was 655 minutes (SD = 35.36), which was about ten minutes less on each non-school night than baseline. Emma spent more time in bed on school nights than non-school nights. During follow-up, Emma's time in bed on Saturday night was adjusted by taking an hour away due to the start of day-light savings in New Zealand. Emma slept for 664.86 minutes (SD = 48.19) on average per night, which was about thirteen minutes less per night from the previous phase. Her mean time in bed on school nights was 682 minutes (SD = 29.07), which indicated that she slept for six minutes less on each school night from the previous phase. On non-school nights, she slept on average for 622 minutes (SD = 73.54), 33 minutes less than each non-school night from the previous phase. She spent more time on Wednesday and Thursday night than of the previous phase. Emma slept longer on school nights than on non-school nights, but all nights were more than or within the recommended range for her age. She had the shortest time in bed on Saturday night and the longest on Wednesday night. She had a friend staying over on Saturday night which delayed her bedtime.

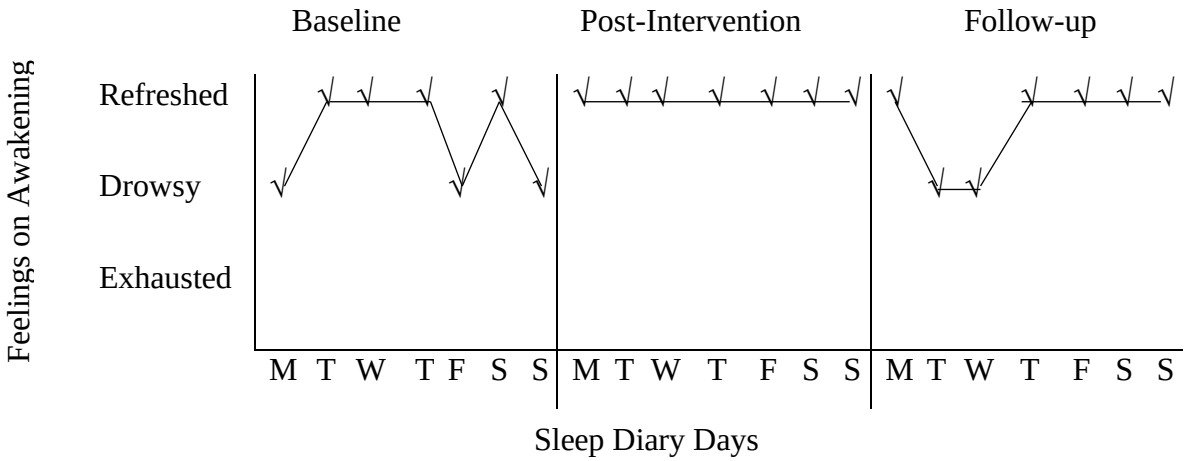

Figure 46. Emma's reported feelings on awakening from Emma's self-report sleep diary for each phase.

Feelings on awakening. Emma's self-reported feelings on awakening for each phase are illustrated by Figure 46. There was an improvement in her reported feelings on awakening from phase A to B_1. These were not maintained during follow-up.

During the baseline phase, Emma reported waking-up feeling "Refreshed" on Tuesday, Wednesday, Thursday and Saturday. She felt "Drowsy" on Monday, Friday and Sunday morning. After she met her goal for sleep education, Emma reported feeling "Refreshed" when waking up on all mornings. Compared with baseline, Emma reported feeling "Refreshed" on three more mornings, indicating an improvement in positive feelings. At follow-up, Emma reported feeling "Refreshed" after waking up on all mornings except for Tuesday and Wednesday when she reported feeling "Drowsy". The improvement of positive feelings from the previous phase were not maintained. She noted that on Monday, she stayed in bed reading for 90 minutes before falling into sleep. She woke up during the middle of the night on Tuesday night.

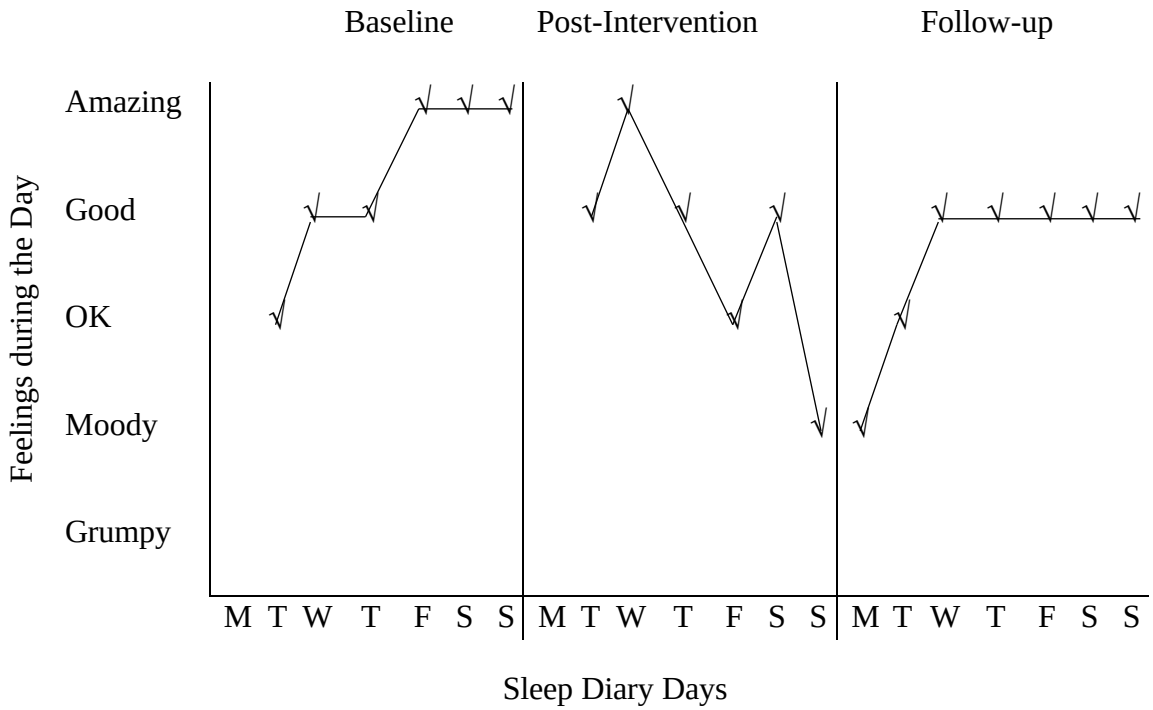

Figure 47. Emma's reported feelings during the day from Emma's self-report sleep diary for each phase.

Feelings during the day. Figure 47 shows Emma's reported feelings during the day for each phase. Emma reported general positive feelings during the day across all three phases.

At baseline, Emma reported feeling "Amazing" on Friday, Saturday and Sunday. She reported feeling "Good" on Wednesday and Thursday whereas she felt "OK" on Tuesday. She did not record her feeling on Monday. After sleep education, Emma reported feeling "Amazing" on Wednesday. She felt "Good" on Tuesday, Thursday and Saturday. She felt "OK" on Friday and "Moody" on Sunday. She did not record her feeling during the day on Monday. These are similar to her reports during baseline. During follow-up, Emma reported feeling 'Good' during the day on all days except for Tuesday when she felt "OK", and on Monday, she felt "Moody". These are similar to her reports during the previous phase.

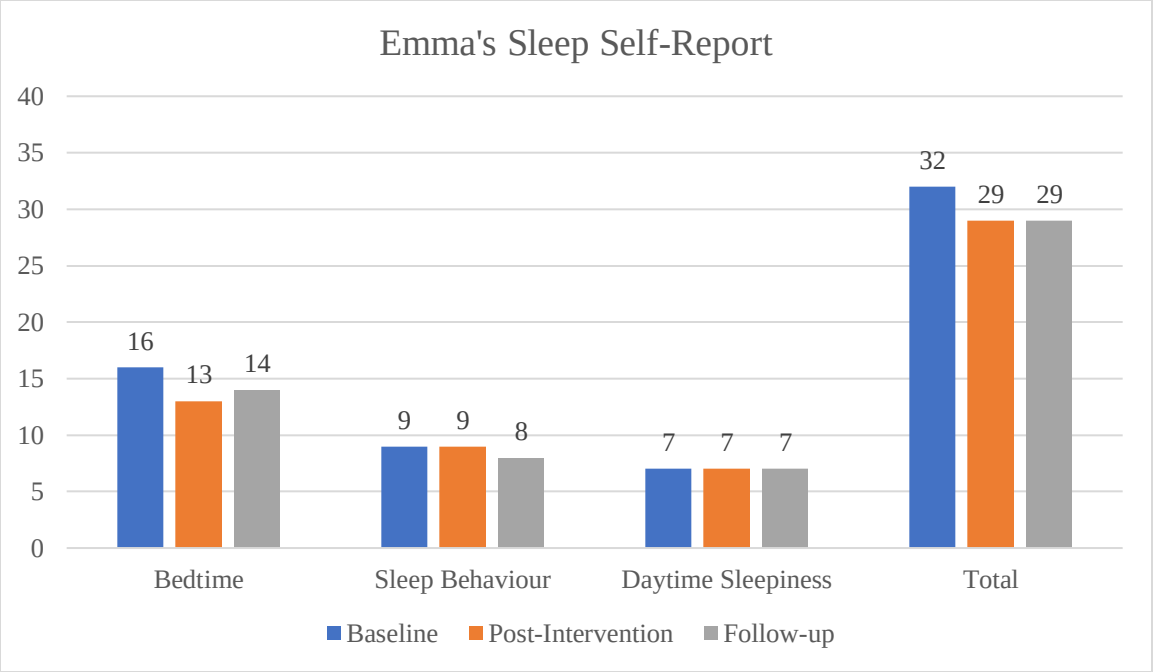

Figure 48. Emma's Sleep Self-report scores. Higher scores indicate more problems.

Sleep-Self Report (SSR). Emma completed the SSR questionnaire for all phases as scheduled. The SSR scores are illustrated by Figure 48. Emma's SSR total score decreased following the YIC programme, indicating an improvement in reported sleep problems, and the improvement was maintained at follow-up.

While Emma's SSR Sleep Behaviour score and Daytime Sleepiness score did not change, her SSR Bedtime score decreased following the Sleep Education as compared with baseline, resulting in the decline of the SSR total score. This indicated that Emma reported fewer sleep problems at bedtime. Items Emma rated suggesting improvement were "Do you fall asleep in about 20 minutes", and "Are you afraid of the dark". At follow-up, the decreased number of problems was maintained. It shows that Emma has overall fewer sleep problems after Sleep Education, particularly around bedtime, and these improvements were maintained.

Both Emma parents set bedtime sleep rules for her, and she reported having trouble sleeping at all three phases. Emma reported sometimes liking to go to sleep at all phases.

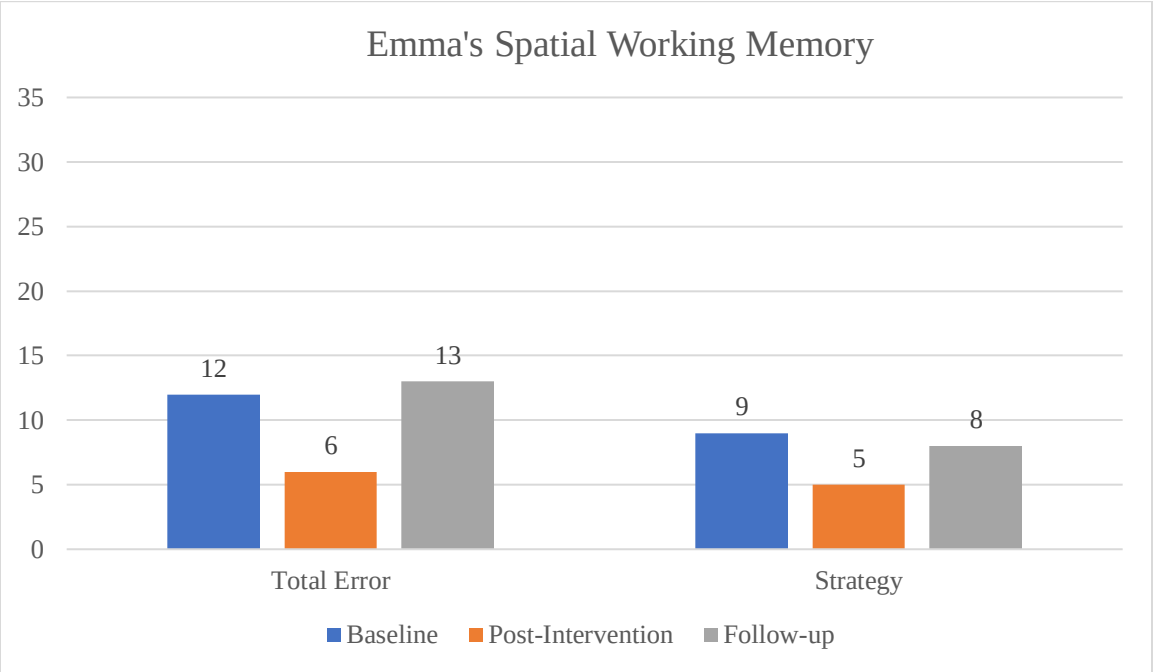

Figure 49. Emma's Spatial Working Memory Task scores. Lower scores indicate fewer errors, and improved strategy.

Spatial Working Memory (SWM). Emma completed the SWM measures for all phases as scheduled. Both the total error score and strategy score decreased following the YIC programme (Figure 49) indicating improvement in working memory accuracy and strategy. The improvement was not maintained at follow-up.

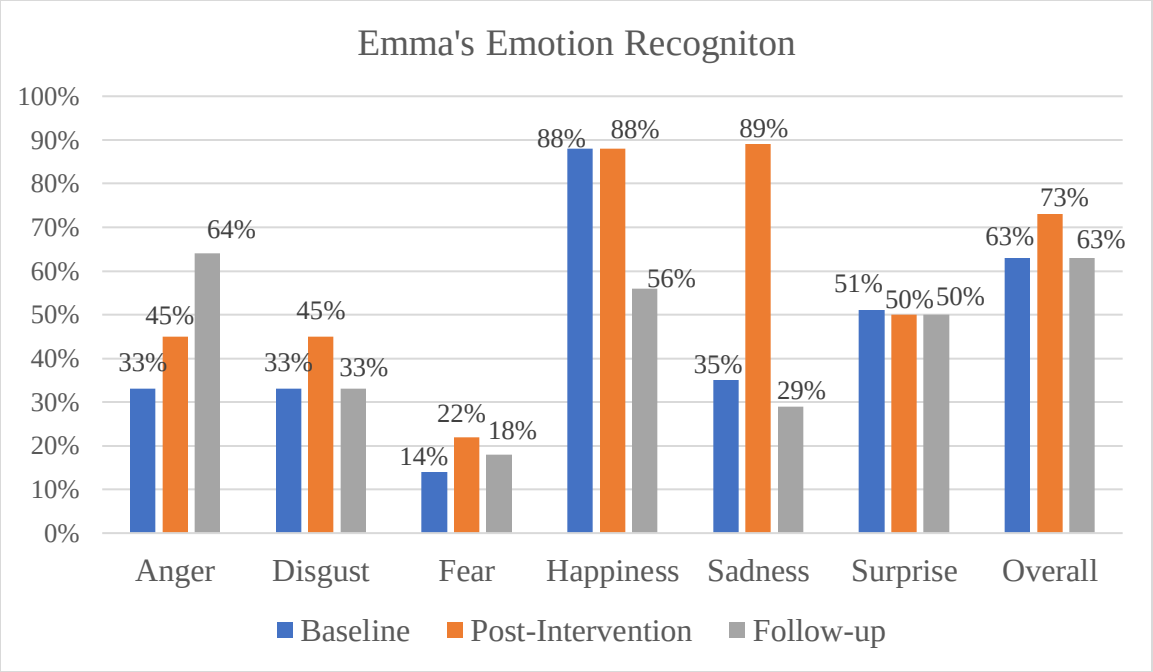

Figure 50. Emma's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion Recognition Task (ERT). Emma completed the ERT measures for all phases as scheduled. As shown by figure 50, The overall accuracy of emotion recognition and the accuracy of emotion recognition on every emotion, except "surprise", increased following the Sleep Education programme, indicating improvement in emotion recognition. The improvement was not maintained at follow-up.

Emma's overall median reaction time to pair a facial expression with an emotion was decreased following the Sleep Education programme (1.32 seconds vs. 1.08 seconds). It showed that Emma spent less time in selecting an emotion after a facial expression was presented to her after Sleep Education. She improved in both speed and accuracy. However, this improvement in speed was not maintained at follow-up.

Overall, Emma achieved full engagement in the sleep education programme, and she accomplished her goal, as backed up by the sleep diary data. She slept the recommend length of time or longer every night during all phases. After sleep education, although Emma's time in bed decreased, she reported feeling refreshed on more mornings. The reported positive feelings on awakening were not maintained at follow-up. Her self-reported feelings during the day did not change across phases. Emma reported fewer sleep problems post-intervention, and this improvement was maintained. Following sleep education, both Emma's working memory accuracy and strategy improved, as well as her emotion recognition accuracy and speed, however, these improvements were not maintained.

Eva. Eva was fully engaged in YIC programme (Liberty, 2018). She completed both workbooks. She set a sleep goal and achieved it. Her sleep goal was "go to bed within 20 minutes". She reported that the goal was accomplished, and the achievement was maintained. Conversation with Eva during phase B_2 revealed that Eva decided not to read too much before bedtime so that she can sleep longer. She reported sleeping well in general.

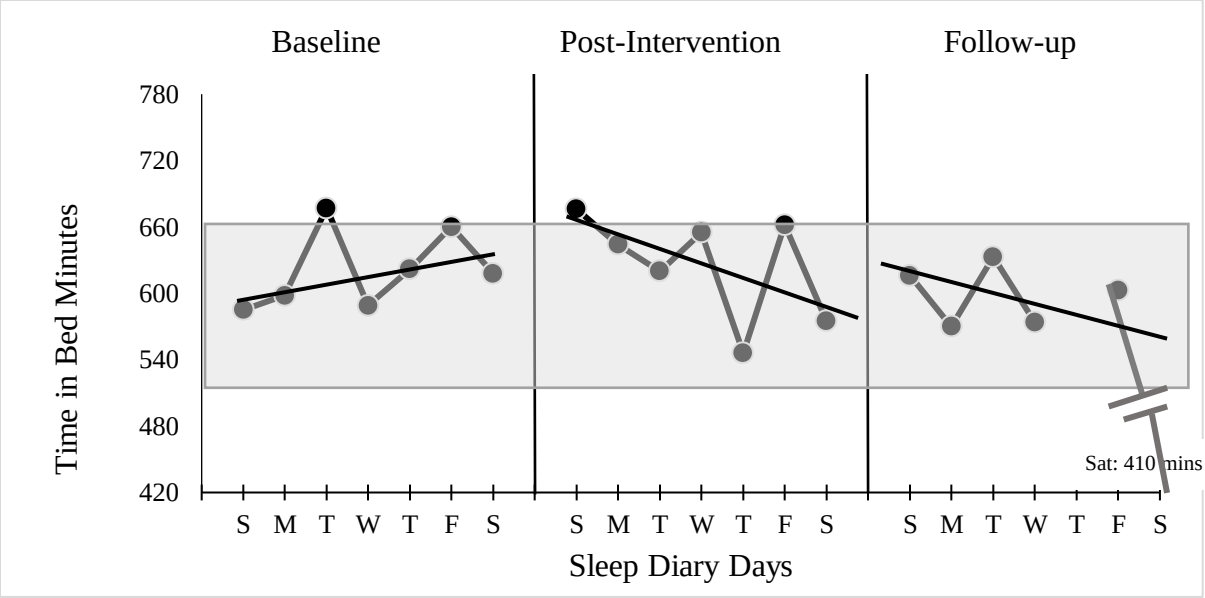

Figure 51. Repeated measures of time in bed in minutes from Eva's self-report sleep diary for each phase, and split-middle trend lines (Cooper et al., 2007).

Note: The shaded area shows the recommended time in bed of 9 to 11 hours for school-aged children between 6 – 13 years (Hirshkowitz et al., 2015).

Repeated Measures.

Time in bed. Eva's time in bed during all phases is presented in Figure 51. Eva's time in bed did not change after sleep education, it decreased during follow-up. Comparing Eva's time in bed with that recommended for the age group, Eva slept the recommended length of time or longer on every night, except one night during follow-up, which she had an early flight to catch.

Trend analysis indicates that Eva's time in bed increased during the baseline phase. Her longest night was Tuesday night, and the shortest night was Sunday night. Trend analysis shows that her time in bed decreased after sleep education. She had the longest time in bed on Sunday night and the shortest time in bed on Thursday night. Compared with baseline, Eva spent more time in bed on Sunday, Monday and Wednesday nights. She noted that she had a friend staying over on Saturday night, which delayed her bedtime. Trend analysis shows that her time in bed decreased during the follow-up phase. Compared with the previous phase, Eva spent more time

in bed on Tuesday and Wednesday nights, and she slept the recommended length of time or longer on all nights except for Saturday. Eva explained that the short time in bed on Saturday night was due to catching an early international flight on Sunday morning.

Eva's average time in bed at baseline was 621.29 minutes (SD = 35.39). She spent more time in bed on weekends than on school nights (Mean = 639.0, SD = 29.70 vs. Mean = 614.2, SD = 37.93). During phase B_1, Eva spent 625.43 minutes in bed on average per night (SD = 48.30), which was about the same as the average time in bed at baseline. On school nights, Eva slept for 628.2 minutes (SD = 50.19) on average, fourteen minutes more per school night than the previous phase. On non-school nights, Eva's average time in bed was 618.5 minutes (SD = 61.52), 20 minutes less on each non-school night than baseline. She spent more time in bed on school nights than non-school nights. During phase B_2, Eva's time in bed on Saturday night was adjusted by taking an hour away due to the start of day-light savings in New Zealand. Her time in bed on Thursday night during the follow-up phase was not available because she could not remember the wake-up time on Friday morning. Eva slept for 567.67 minutes (SD = 80.94) on average per night, which was about 57 minutes less per night than the previous phase. Her mean time in bed on school nights was 598.25 minutes (SD = 31.14), 30 minutes less on each school night than the previous phase. On non-school nights, she slept on average for 506.5 minutes (SD = 136.47), twelve minutes less than each non-school night from the previous phase. Eva spent more time in bed on school nights than on non-school nights. She had the shortest time in bed on Saturday night and the longest on Tuesday night.

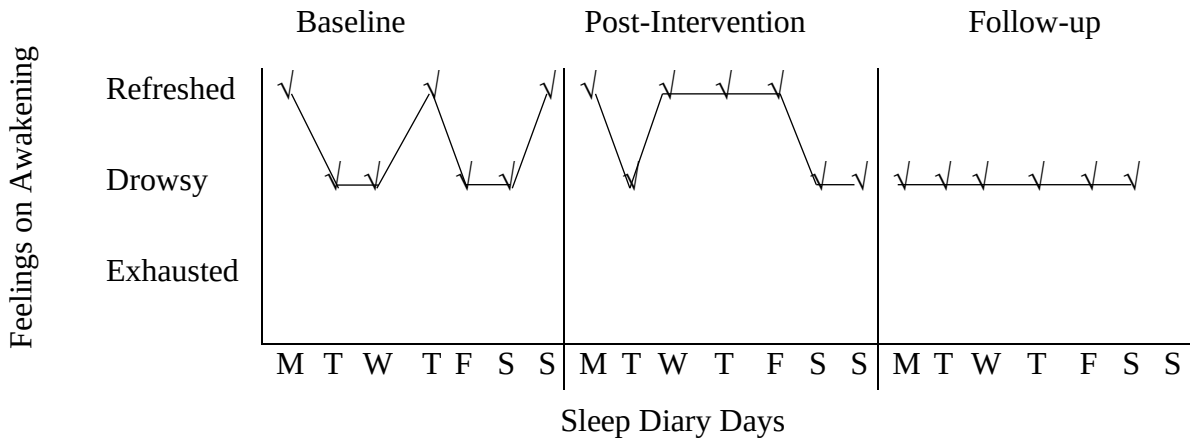

Figure 52. Eva's reported feelings on awakening from Eva's self-report sleep diary for each phase.

Feelings on awakening. Eva's self-reported feelings on awakening for each phase are illustrated by Figure 52. Her reports during phase B_1 were similar to her reports during phase A. There was a reduction in her reports during follow-up.

Eva reported waking-up feeling "Refreshed" on Monday, Thursday and Sunday, and "Drowsy" on all other mornings. Eva recalled waking up a few times during Monday night and her mother said she did a lot of sleep talking. On Thursday night, she stayed up late to read. She noted that she had an "amazing" sleep on Saturday night. Following sleep education, Eva reported feeling "Refreshed" on Monday, Wednesday, Thursday and Friday mornings, "Drowsy" on Tuesday, Saturday and Sunday mornings. These were similar to her reports during baseline. During follow-up, Eva reported feeling "Drowsy" after waking up on all mornings except for Sunday, where data were not available. These were worse than her reports from any of the previous two phases.

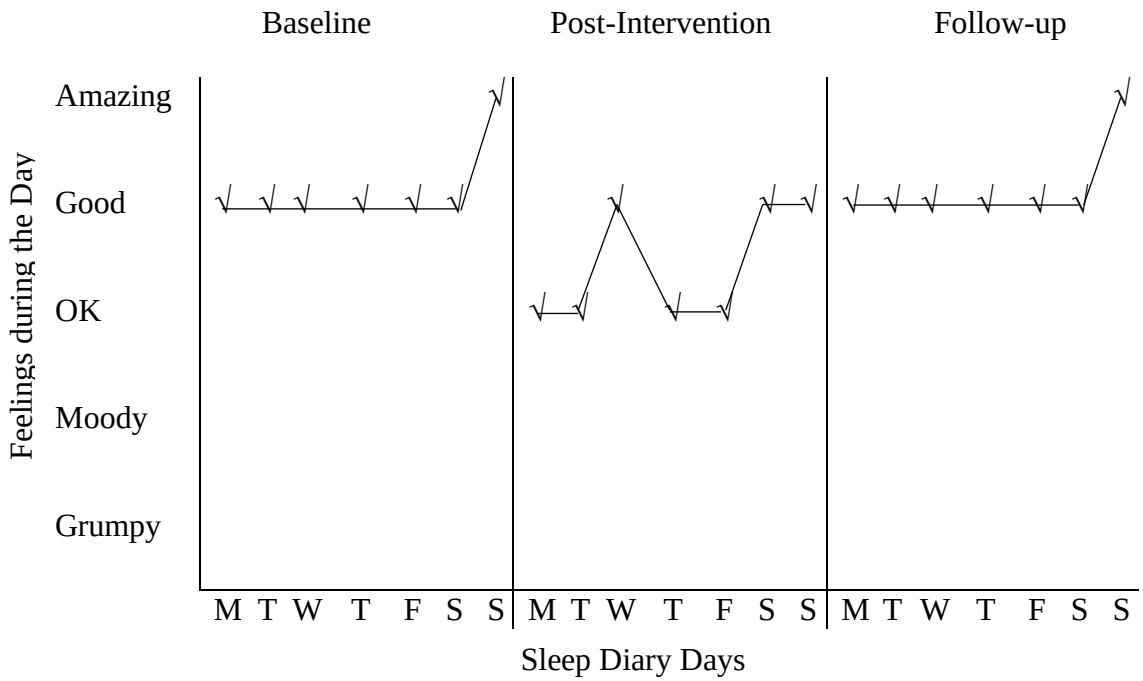

Figure 53. Eva's reported feelings during the day from Eva's self-report sleep diary for each phase.

Feelings during the day. Eva's reported feelings during the day for each phase are illustrated by Figure 53. She reported generally positive feelings during the day during all phases.

During baseline, she reported feeling "Good" on all school days and Saturday. She felt "Amazing" on Sunday. Following sleep education, Eva reported feeling "Good" on Wednesday, Saturday and Sunday. She felt "OK" on Monday, Tuesday, Thursday and Friday. These positive feelings were similar to her reports during baseline. At follow-up, she reported feeling 'Good' during the day on all school days and on Saturday. She felt amazing on Sunday. These positive feelings during the day were similar to her reports from the previous two phases.

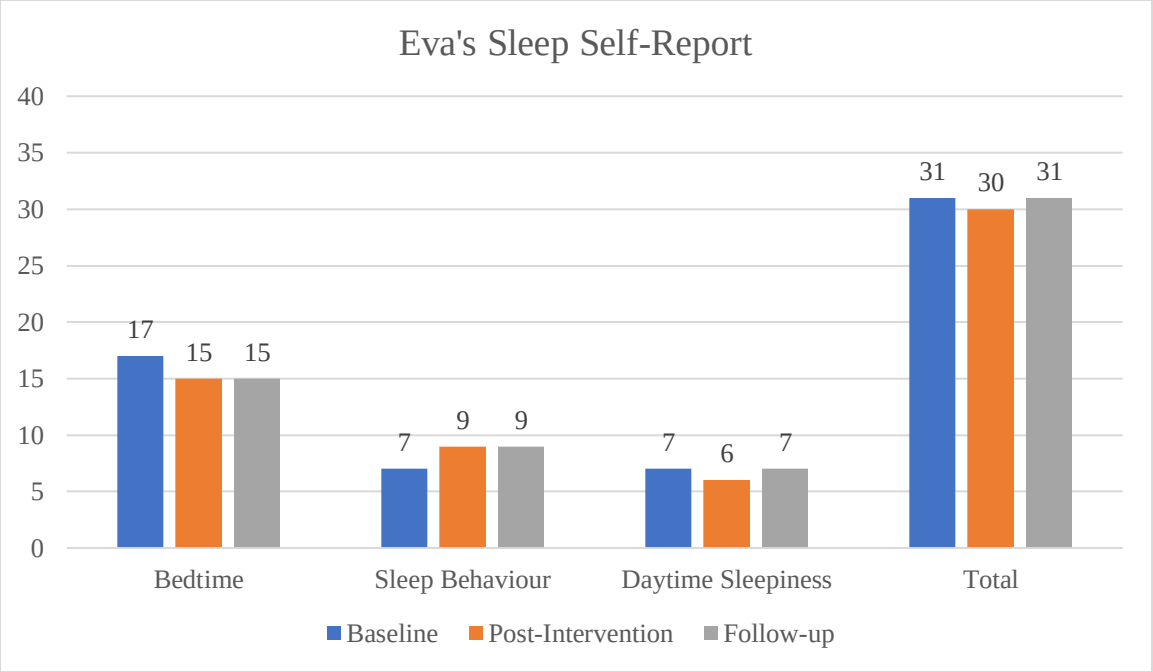

Figure 54. Eva's Sleep Self-report scores. Higher scores indicate more problems.

Sleep-Self Report (SSR). Eva completed the SSR questionnaire for all phases as scheduled. The SSR scores are illustrated by Figure 54. Her SSR total scores were similar at all phases, indicating no change in self-reported sleep problems.

Eva's SSR Bedtime subscale score and SSR daytime sleepiness subscale score all decreased following the sleep education as compared with baseline demonstrating some improvement after sleep education. The improvement around bedtime was maintained at follow-up. Items Eva rated suggesting improvement were "Do you go to bed at the same time every night on school nights", "Do you fight with your parents about going to bed", and "Are you ready for bed at your usual bedtime". Nevertheless, it was harder for her to go to bed. Eva's SSR Sleep Behaviour subscale score increased at phase B1, indicating more problems with sleep behaviours. Items Eva rated more problematic were "Do you think you sleep too little", and "Do you wake up at night when your parents think you are asleep". No improvement was observed from SSR Sleep Behaviour subscale score at follow-up.

Both Eva's parents set sleep rules for her at phase A, her mother set bedtime sleep rules for her at phase B_1 and phase B_2. She reported having trouble sleeping at all phases. Eva liked to go to sleep at all phases.

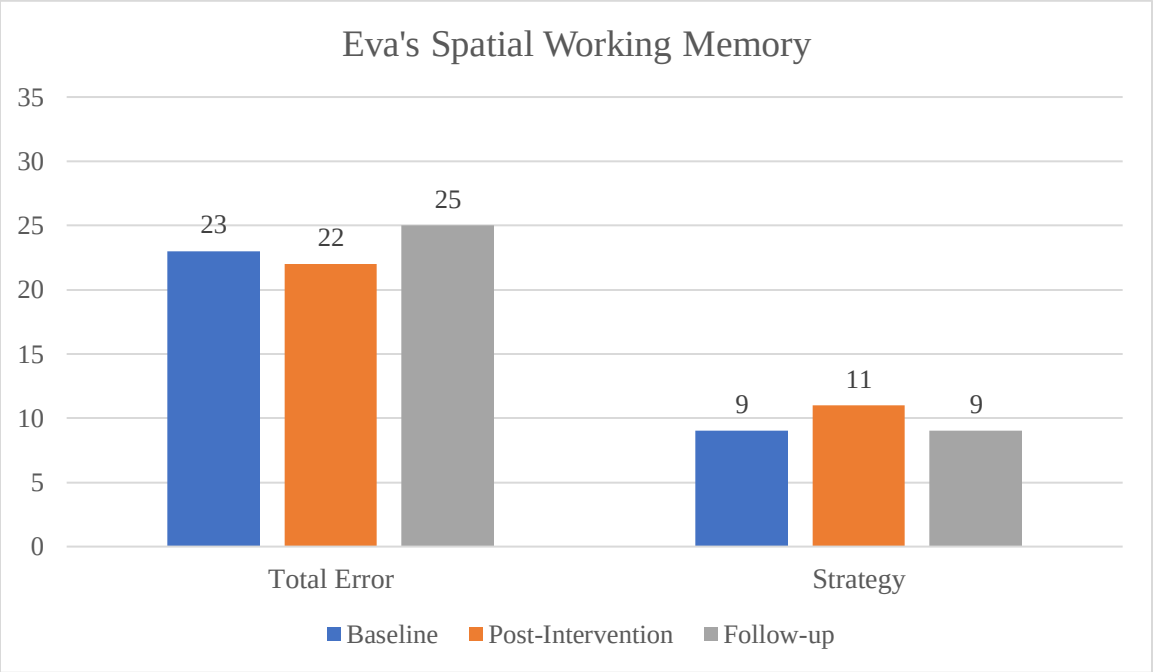

Figure 55. Eva's Spatial Working Memory Task scores. Lower scores indicate fewer errors, and improved strategy.

Spatial Working Memory (SWM). Eva completed the SWM measures for all phases as scheduled. Eva's total error score decreased by one point following the YIC programme (Figure 55) indicating a slight improvement in working memory accuracy. It worsened at follow-up. Eva's strategy score increased after sleep education and decreased to baseline at the follow-up phase indicating no improvement in working memory strategy.

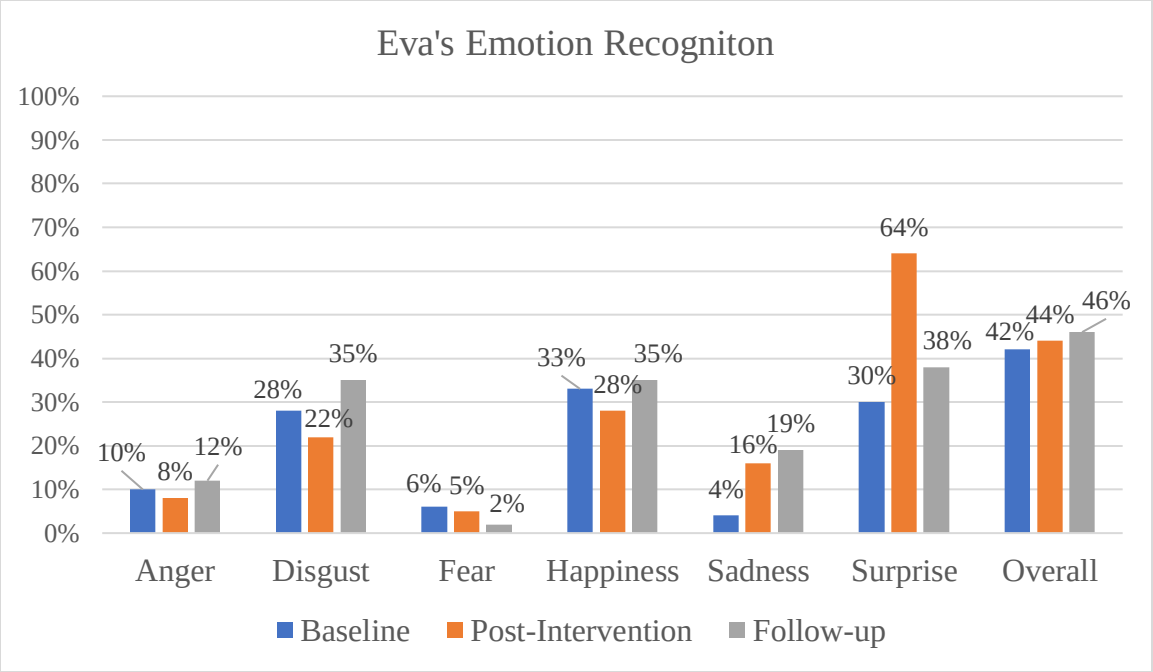

Figure 56. Eva's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion Recognition Task (ERT). Eva completed the ERT measures for all phases as scheduled. The accuracy of emotion recognition increased following the YIC programme and continued to increase at follow-up (Figure 56) indicating an improvement in emotion recognition. Among all the emotions, the accuracy in recognizing sadness and surprise increased after sleep education and continued to increase at follow-up.

Eva's overall median reaction time to pair a facial expression with an emotion was about the same following the YIC programme (1.26 seconds vs. 1.31 seconds) and increased slightly at the follow-up phase (1.47 seconds). It showed that Eva spent about the same amount of time or more selecting an emotion after a facial expression was presented to her.

Overall, Eva was fully engaged in the YIC programme (Liberty, 2018). Her goal was accomplished, and the achievement was maintained. Eva's time in bed did not improve. Eva slept the recommended time for her age on all nights during all phases except for one night due to an early flight. Eva's reported feelings on awakening did not change after sleep education. It declined during follow-up. Her reports of positive feelings during the day remained consistent across phases. Eva reported fewer sleep problems at bedtime but more sleep behaviour problems. A slight improvement was observed on Eva's working memory accuracy but not strategy. The overall emotion recognition accuracy was improved and maintained whereas the speed did not change.

Edith. Edith demonstrated full engagement in the YIC programme (Liberty, 2018). She completed both workbooks. Edith's sleep goal was "sleep before 11pm". Her goal was reported accomplished, and the achievement was maintained. The study researcher checked Edith's recorded bedtimes from her sleep diaries for phase B_1 and phase B_2, it revealed that although Edith's bedtimes during phase B_1 were irregular, her bedtimes during phase B_2 were more consistent and were around 11pm. Conversation with Edith during phase B_1 revealed that Edith felt waking-up refreshed on more mornings in general. Conversation with Edith during phase B_2 revealed that Edith completely stopped daytime napping. She reported sleeping better at night in general including waking up less often during the night, and Edith also reported not having nightmares anymore at follow-up.

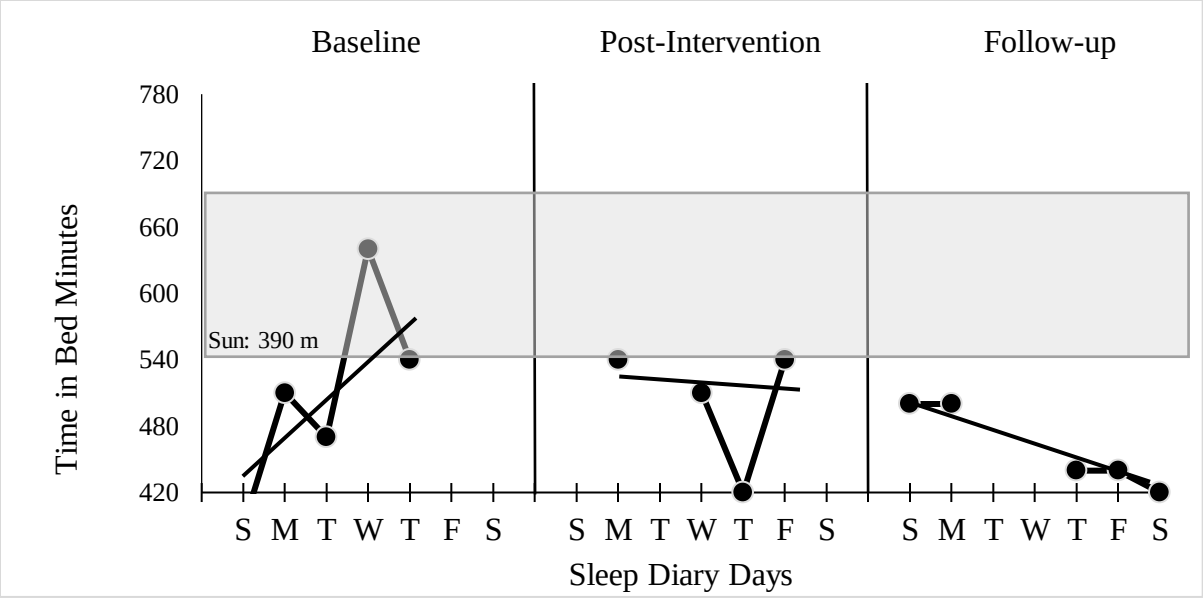

Figure 57. Repeated measures of time in bed in minutes from Edith's self-report sleep diary for each phase, and split-middle trend lines (Cooper et al., 2007).

Note: The shaded area shows the recommended time in bed of 9 to 11 hours for school-aged children between 6 – 13 years (Hirshkowitz et al., 2015).

Repeated Measures.

Time in bed. Edith's time in bed during all phases is presented in Figure 57. Edith's time in bed did not improve following the sleep education nor during follow-up. However, compared with baseline, Edith's time in bed was more consistent across nights after sleep education, and this improvement was maintained during follow-up. Comparing Edith's time in bed with that recommended for her age group, she still slept less than the recommended length of time after sleep education on half of the nights, this did not improve during follow-up.

Trend analysis indicates that Edith's time in bed increased during the baseline phase. Her longest night was Wednesday night, and the shortest night was Sunday night. Her time in bed was less than the recommended duration on three out of five nights. Trend analysis indicates that her time in bed was stabilized after sleep education. Compared with baseline, Edith slept more

on Monday. Comparison of time in bed between phase A and phase B_1 on Sunday, Tuesday and Saturday was not available due to the lack of sleep data. Edith spent less than the recommended length of time in bed for her age on two out of four nights. Trend analysis shows that her time in bed decreased during the follow-up phase. Comparing Edith's time in bed with that recommended for her age group, she slept less than the recommended length of time on all nights.

During baseline, time in bed on Friday and Saturday were not reported. As a result, Edith's average time in bed was calculated across school nights only. Her average time in bed was 510 minutes (SD = 91.92), which was less than the recommended duration for children of her age group. During phase B_1, when data were not available for Sunday, Tuesday and Saturday nights, Edith's average time in bed was 502.5 minutes (SD = 56.79), eight minutes less than her average time in bed during the baseline phase. She spent twenty minutes less per school night (B_1 Mean = 490, SD = 62.45, vs. A Mean = 510, SD = 91.92) than the previous phase. Edith had the shortest time in bed on Thursday night and the longest on Monday and Friday nights. During follow-up, Edith's time in bed on Saturday night was adjusted by taking an hour away due to the start of day-light savings in New Zealand. Her time in bed on Tuesday and Wednesday nights were not recorded. Edith's mean time in bed was 460 minutes (SD = 37.42), which was about 42 minutes less per night from the previous phase. Her mean time in bed on school nights was 480 minutes (SD = 34.64), ten minutes less than the previous phase. On non-school nights, she spent on average 430 minutes (SD = 14.14) per night in bed. She spent more time in bed on school nights than on non-school nights. She had the shortest time in bed on Saturday night and the longest on Sunday and Monday nights.

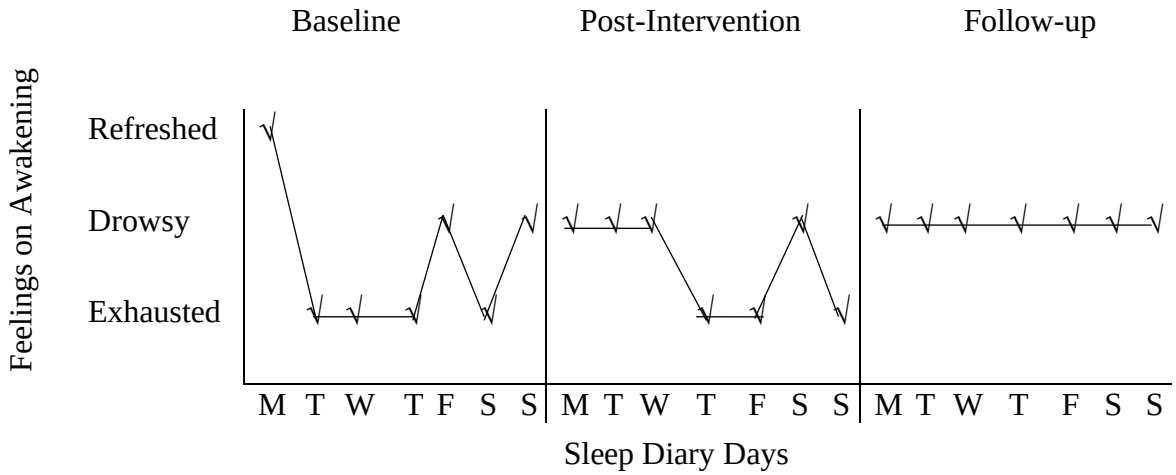

Figure 58. Edith's reported feelings on awakening from Edith's self-report sleep diary for each phase.

Feelings on awakening. Edith's self-reported feelings on awakening for each phase are illustrated by Figure 58. Her reports during phase B_1 were similar to her reports during phase A. Edith's reports during the following-up improved as she did not report feeling exhausted any longer.

During the baseline phase, Edith reported waking-up feeling "Refreshed" on Monday morning. She felt "Drowsy" on Friday and Sunday mornings. She felt "Exhausted" on the other mornings. After sleep education, Edith reported feeling "Drowsy" on Monday, Tuesday, Wednesday and Saturday mornings. She felt "Exhausted" on Thursday, Friday and Sunday mornings. These were similar to her reports from the previous phase. At phase B_2, Edith reported feeling "Drowsy" after waking-up on all mornings. She did not report feeling "Exhausted" on any mornings indicating an improvement during follow-up.

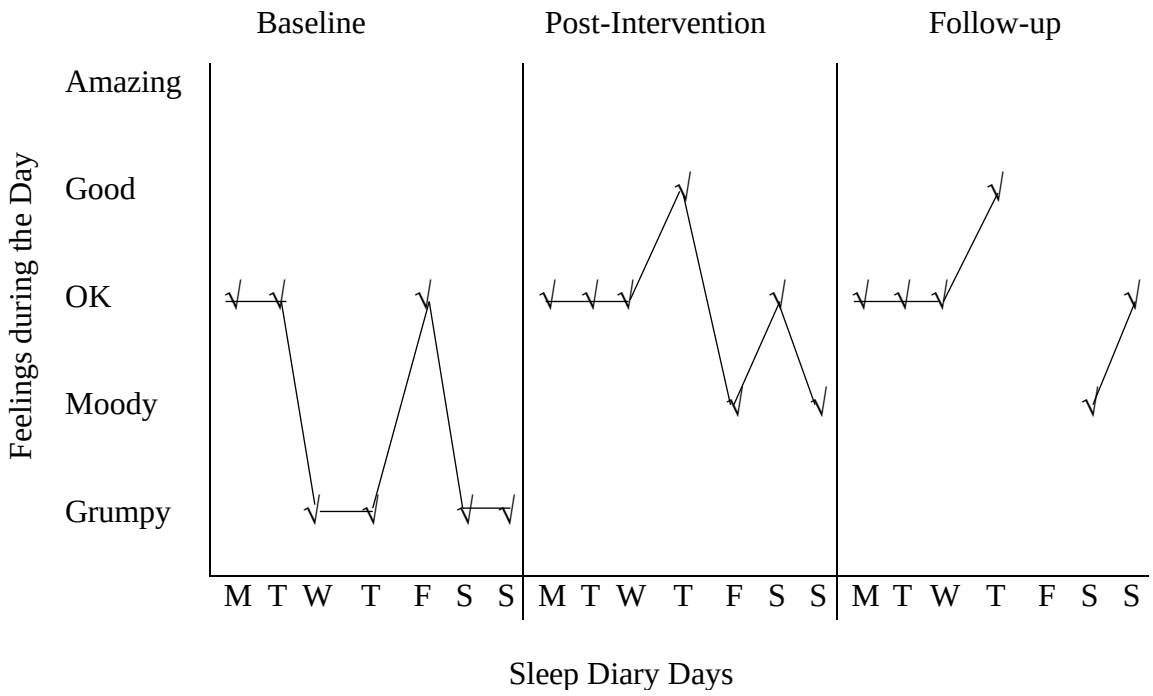

Figure 59. Edith's reported feelings during the day from Edith's self-report sleep diary for each phase.

Feelings during the day. Edith's reported feelings during the day for each phase are illustrated by Figure 59. There was an improvement in her reported feelings during the day from phase A to B_1, and the improvement was maintained during phase B_2.

At baseline, she reported feeling "OK" on Monday, Tuesday and Friday. She reported feeling "Grumpy" on other days. Edith reported feeling "Good" on Thursday, feeling "OK" on Monday, Tuesday, Wednesday and Saturday. She felt "Moody" on Friday and Sunday. Edith no longer reported "Grumpy" on any days, which is an improvement from baseline. She reported feeling "Good" on Thursday, "OK" on Monday, Tuesday, Wednesday and Sunday. She felt "Moody" on Saturday. She did not record her feeling during on Friday. It showed that the improvement in positive feelings throughout the day was maintained during follow-up.

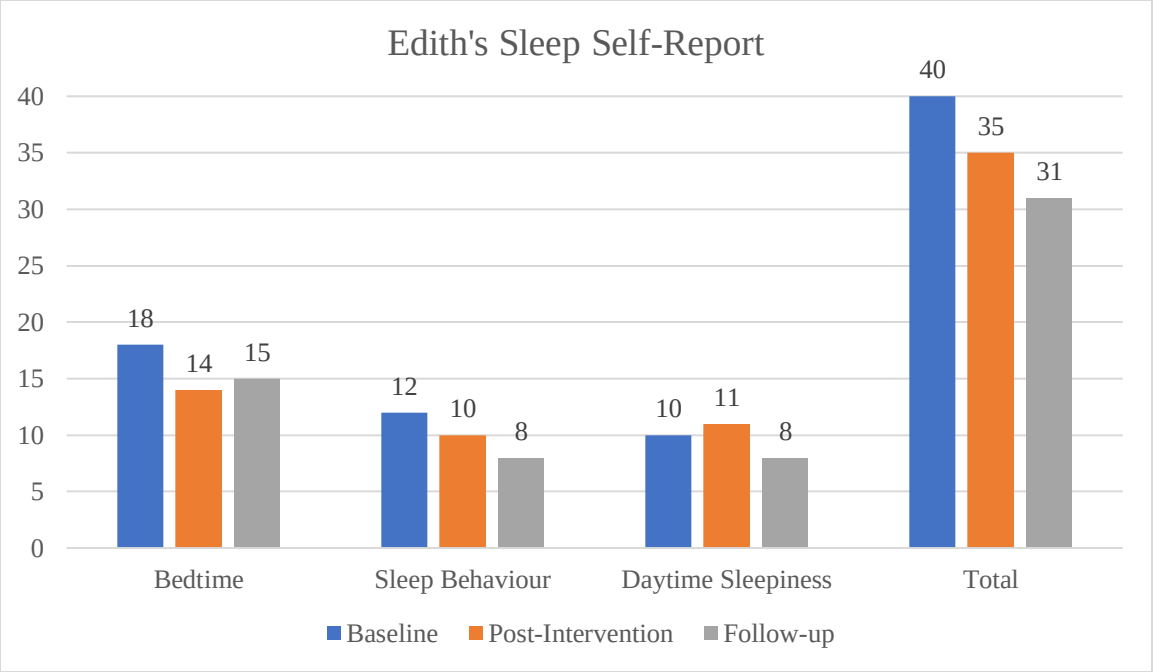

Figure 60. Edith's Sleep Self-report scores. Higher scores indicate more problems.

Sleep-Self Report (SSR). Edith completed the SSR questionnaire for all phases as scheduled. The SSR scores are illustrated by Figure 60. There was a decline in the SSR Total scores from phase A to B_1, indicating an improvement in self-reported sleep problems. The improvement was maintained at follow-up.

Edith's Sleep Self-Report Bedtime subscale score, Sleep Behaviour subscale score, and her SSR total score decreased following sleep education as compared with baseline, and this decreased number of problems was maintained at the follow-up phase, indicating improvement in reported sleep problems. Items Edith rated suggesting improvement were "Do you go to bed at the same time every night on school nights", "Is it hard for you to go to bed", "Are you ready for bed at your usual bedtime", "Do you stay up late when your parents think you are asleep", "Do you think you sleep too much", and "Do you have trouble falling back to sleep if you wake up during the night". Items improved at follow-up were "Do you wake up at night when your parents think you are asleep". Edith also reported not having nightmares anymore at follow-up.

The SSR Daytime Sleepiness score increased slightly after Sleep Education as Edith reported more often feeling sleepy and rarely felt rested after a night's sleep. However, improvement at follow-up was observed as Edith reported rarely taking naps anymore.

Edith's mother set bedtime sleep rules for her at all three phases. She reported having trouble sleeping at all phases. Edith liked to go to sleep sometimes at phase A, she liked to go to sleep at all times at phase B_1 and B_2.

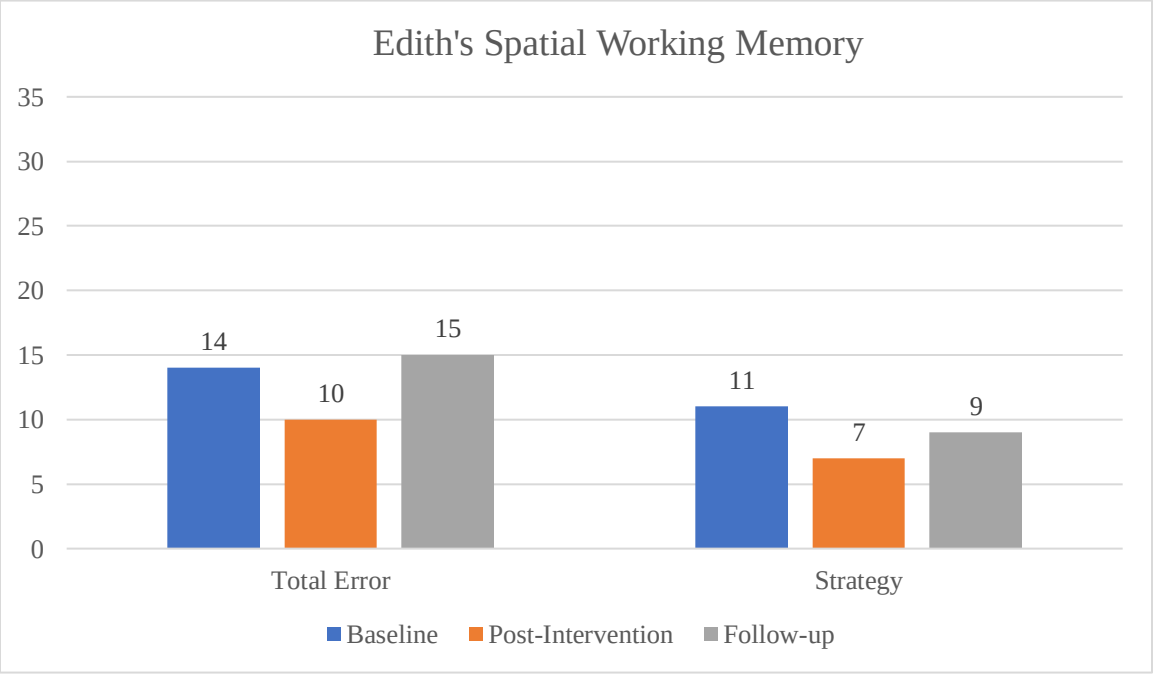

Figure 61. Edith's Spatial Working Memory Task scores. Lower scores indicate fewer errors, and improved strategy.

Spatial Working Memory (SWM). Edith completed the SWM measures for all phases as scheduled. As shown in Figure 61, Edith's total error score and strategy score decreased following the YIC programme (Liberty, 2018), indicating improvement in working memory. The improvement was not maintained at follow-up.

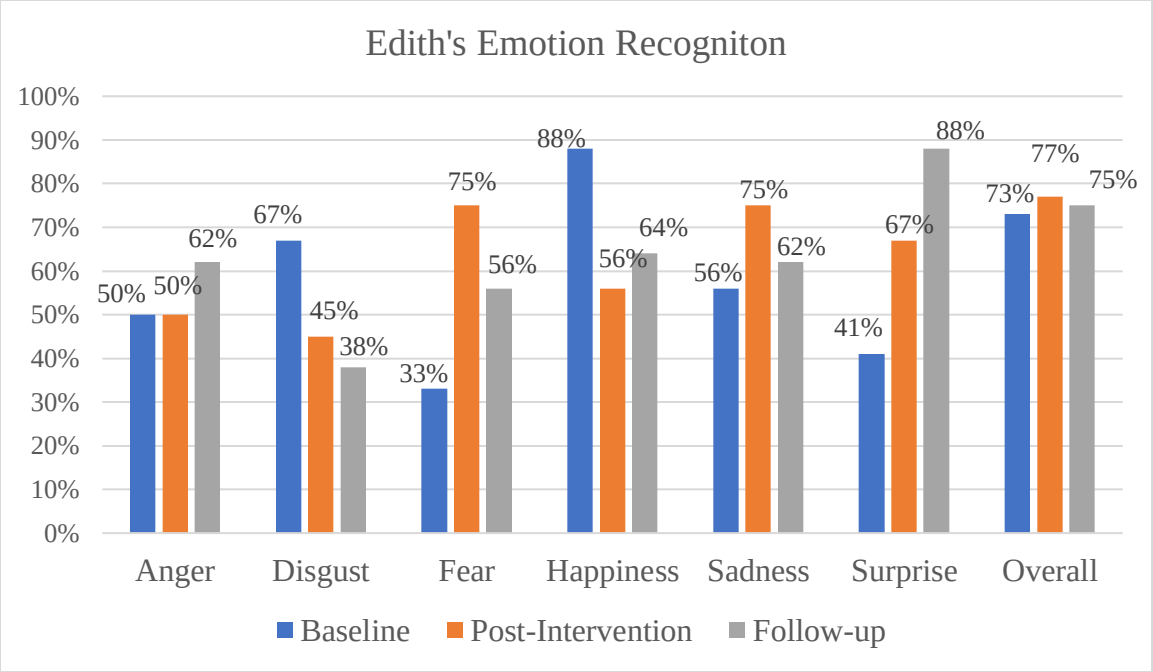

Figure 62. Edith's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion Recognition Task (ERT). Edith completed the ERT measures at all phases as scheduled. The accuracy of emotion recognition increased following the YIC programme (Liberty, 2018), indicating an improvement in emotion recognition (Figure 62). It declined at follow-up compared with the previous phase, yet it remained higher than baseline. Among all the emotions, the accuracy in recognizing fear, sadness and surprise increased after sleep education. The improvement of accuracy in recognizing surprise was maintained at follow-up.

Edith's overall median reaction time to pair a facial expression with an emotion increased following sleep education (from 1.44 seconds to 1.75 seconds). It showed that Edith spent more time selecting an emotion after a facial expression was presented to her. The median reaction time decreased to 1.2 seconds at follow-up.

Overall, Edith demonstrated full engagement in the programme. She reported achieving and maintaining her sleep goal. Her time in bed did not increase, and she slept less than the recommended time for her age group on most if not all nights. However, her time in bed was more consistent across nights following sleep education and during follow-up. Edith's reported feelings on awakening did not change after sleep education, however, she did not report waking up feeling exhausted any longer during follow-up. Her reported feelings during the day improved after sleep education, and she did not feel "Grumpy" anymore after sleep education nor during follow-up. After sleep education, Edith reported fewer overall sleep problems, and even fewer at follow-up. Conversation with the study researcher revealed that Edith took naps less often after sleep education, and she completely stopped daytime napping at follow-up. Her working memory accuracy and strategy improved but the improvements were not maintained at follow-up. Her overall emotion recognition accuracy improved after sleep education whereas the speed improved at follow-up only.

Summary and Analysis

Intervention engagement. All ten children completed the *Sleep Inquiry Book*. Seven of the ten children completed the *I Am A Sleep Scientist Book* and set sleep goals, of which five achieved the sleep goal. Four of these five children stated that the goal-related positive sleep behaviour was maintained during follow-up.

YIC programme goal setting. The overall purpose of YIC programme was that the child learned about sleep and used this information to set their own goal to improve their sleep. Of the seven children who completed the programme and set goals, five (71%) met their goal, and two reported they did not meet their goal. Three children did not engage sufficiently in YIC to set a goal.

Repeated measures.

Time in Bed. Figure 63 shows the repeated measures of time in bed in minutes from all of the study children's self-report sleep diaries for each phase and split-middle trend lines (Cooper et al., 2007). The shaded area indicates the recommended sleep duration of nine to eleven hours for school-aged children between six to thirteen years (Hirshkowitz et al., 2015).

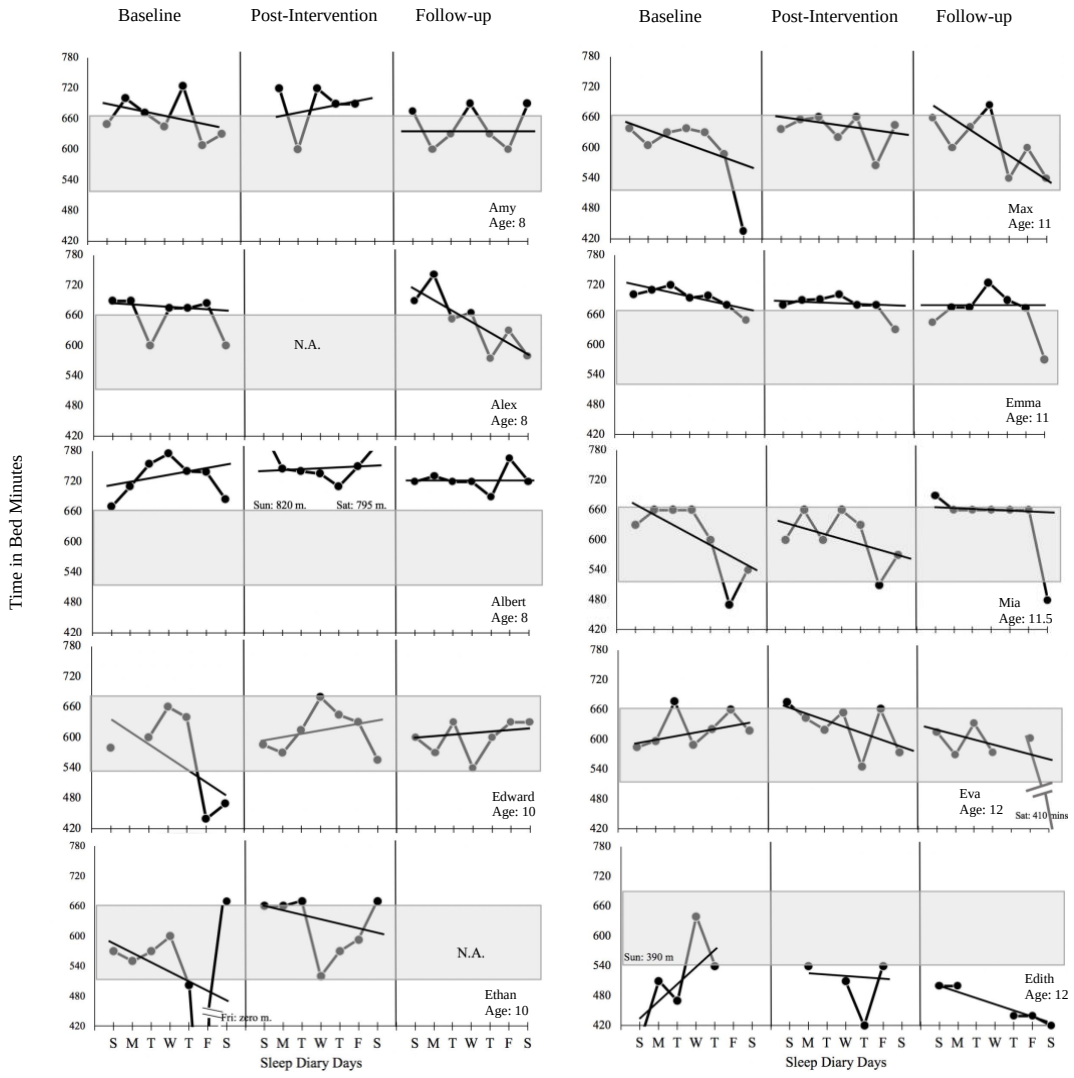

Figure 63. Repeated measures of time in bed in minutes from children' self-report sleep diaries for each phase, and split-middle trend lines (Cooper et al., 2007).

Improvements in time in bed were found in three of the seven children who fully engaged in the YIC programme (Liberty, 2018) after sleep education (Edward, Ethan, and Max); these were maintained for two of them (Edward and Ethan) during follow-up. A decline in time in bed was reported by two of the seven children after sleep education, and it further decreased during follow-up (Emma and Edith). No changes in time in bed was observed across phases for one child (Eva). Another child's (Mia) time in bed improved only during follow-up.

Five of the seven children had one or more nights less than the recommended time during baseline (Edward, Ethan, Max, Mia and Edith). After the YIC programme, three of these five children improved their time in bed to meet the recommended time for their ages every night (Max Edward and Ethan). These improvements were maintained during follow-up. In addition, these five children also showed stabilized time in bed across nights post-intervention (Edward, Ethan, Max, Mia and Edith), and the improvements in consistent time in bed were maintained for two of them (Edward and Edith) during follow-up.

Of the three children who partially engaged in the YIC programme (Liberty, 2018), improvements in time in bed were found in two children after sleep education (Amy and Albert). Comparisons in time in bed between phases for one child were not available due to the lack of post-intervention data. All three children spent the recommended time or longer in bed during all phases. None of them showed more stabilized time in bed across nights after sleep education.

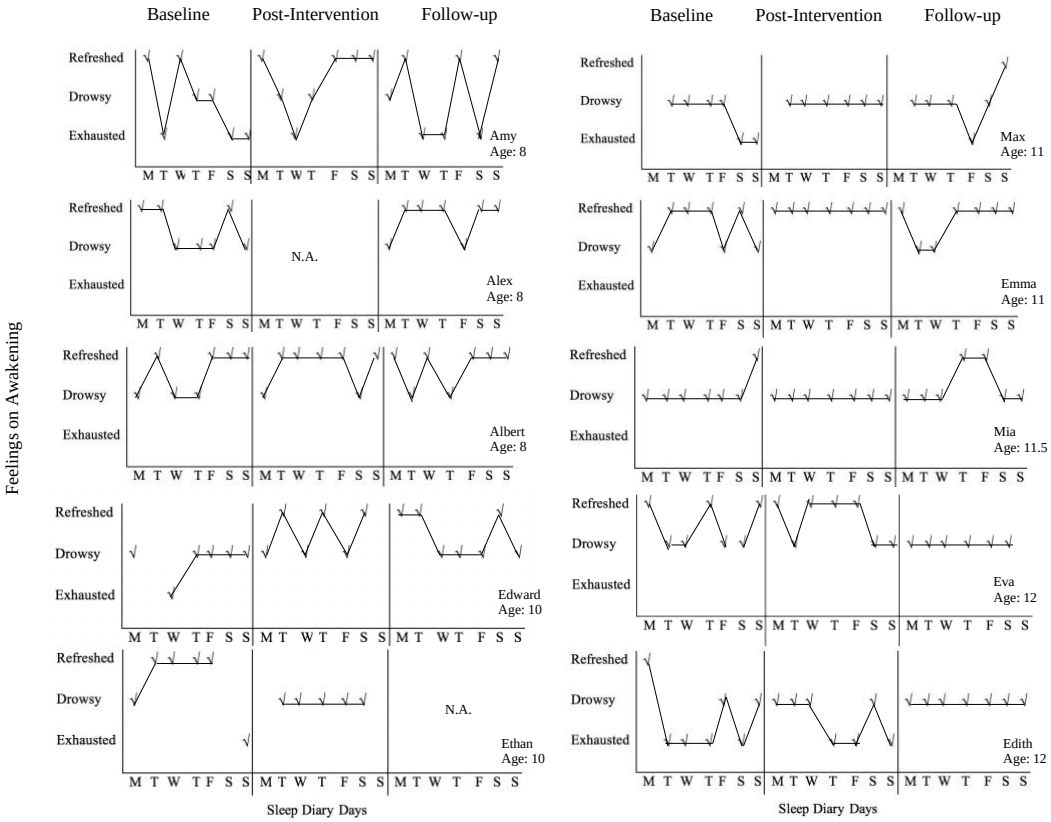

Figure 64. Reported feelings on awakening from children' self-report sleep diaries for each phase.

Feelings on awakening. Figure 64 shows the reported feelings on awakening from children's self-report sleep diaries for each phase. Of the seven children who fully engaged in the YIC programme (Liberty, 2018), three children reported improved feelings on awakening from phase A to phase B_1 (Max, Edward, and Emma); these improved feelings were maintained for two children during follow-up (Max and Edward). Another three children reported similar feelings during phase B_1 as compared with their reports during phase A (Mia, Eva and Edith); during follow-up, one reported slightly better feelings on awakening (Edith), one reported feeling worse (Eva), and one reported similar feelings to the previous phase. One child reported decreased feelings on awakening after sleep education, and his follow-up data was missing.

Of the three children who partially engaged in the YIC programme (Liberty, 2018), two children reported improved feelings on awakening from phase A to phase B_1 (Amy and Albert); these improved feelings were maintained for one during follow-up (Albert). The other child reported improved feelings during follow-up, and his post-intervention data was missing (Alex).

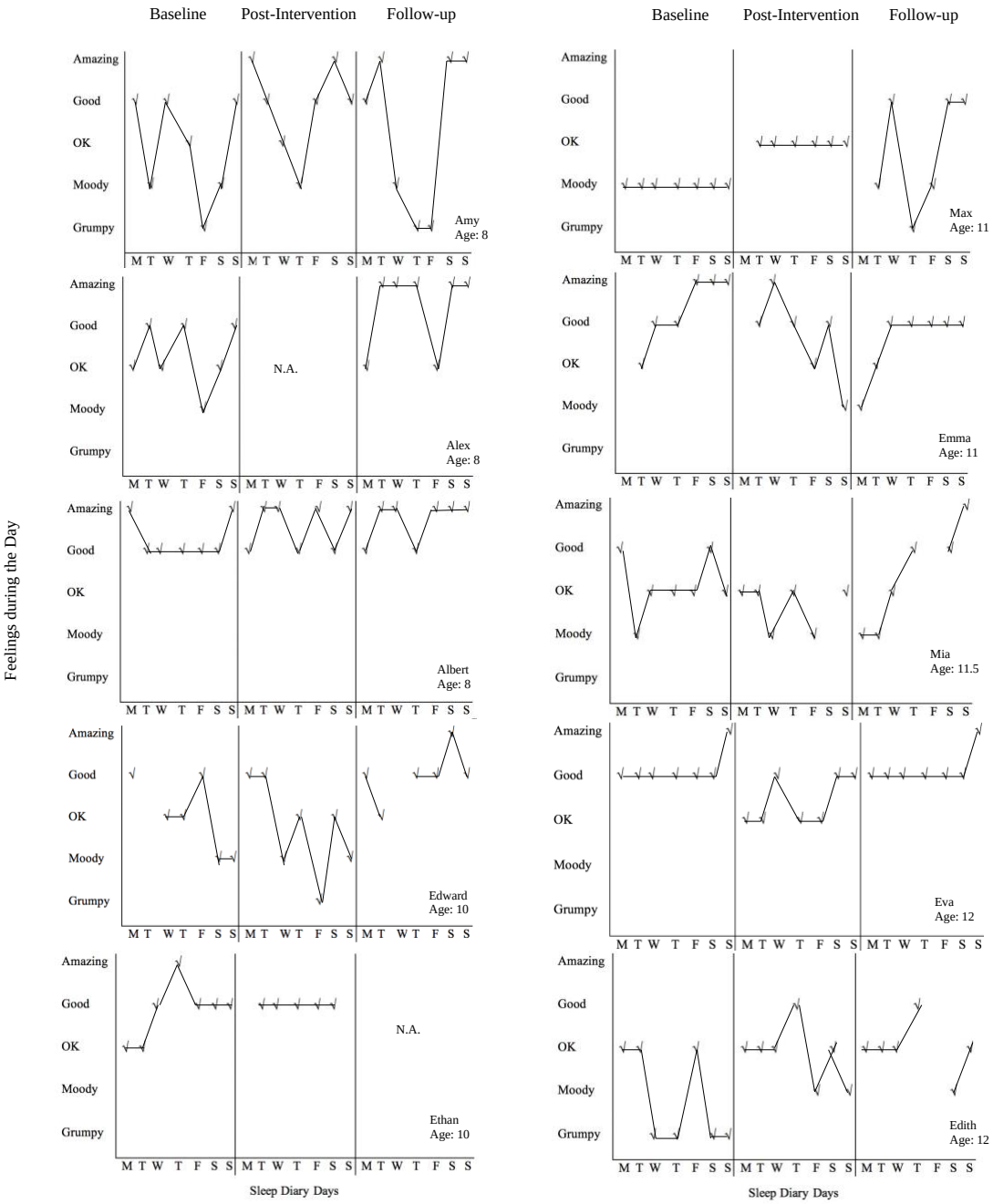

Figure 65. Feelings during the day from children' self-report sleep diaries for each phase.

Feelings during the day. Figure 65 shows the reported feelings during the day from children's self-report sleep diaries for each phase. Of the seven children who fully engaged in the YIC programme (Liberty, 2018), two reported improved feelings during the day from phase A to phase B1 (Max and Edith); these improved feelings were maintained for one child (Edith) during follow-up. Four children's reported feelings during the day did not change across phases (Emma, Eva, Mia and Ethan; Ethan's follow-up data was missing), of which two reported generally positive feelings across all phases (Emma and Eva). One child reported improved feelings during follow-up (Edward).

Of the three children who partially engaged in the YIC programme (Liberty, 2018), one child reported improved feelings during the day after sleep education (Amy); these improved feelings were not maintained during follow-up. One child's reported feelings during the day did not change across phases (Albert), and these reports were generally positive feelings. One child's post-intervention data was missing, and he reported improved feelings during follow-up (Alex).

Analysis of intermittent measures.

Sleep Self-Repot (SSR). Figure 66 shows children' Sleep Self-Report scores in all phases. Higher scores indicate more sleep problems. Of the seven children who fully engaged in the YIC programme (Liberty, 2018), four reported fewer overall sleep problems after sleep education, as shown in the reductions of their SSR total scores (Max, Eva, Emma, and Edith). These included fewer sleep problems at Bedtime (Max, Eva, Emma and Edith), fewer sleep problems with Sleep Behaviour (Max and Edith), and fewer Daytime Sleepiness problems (Eva). At follow-up, the improvements in overall sleep problems were maintained for three children (Max, Emma and Edith). In addition, two children (Ethan and Mia) showed improvements in

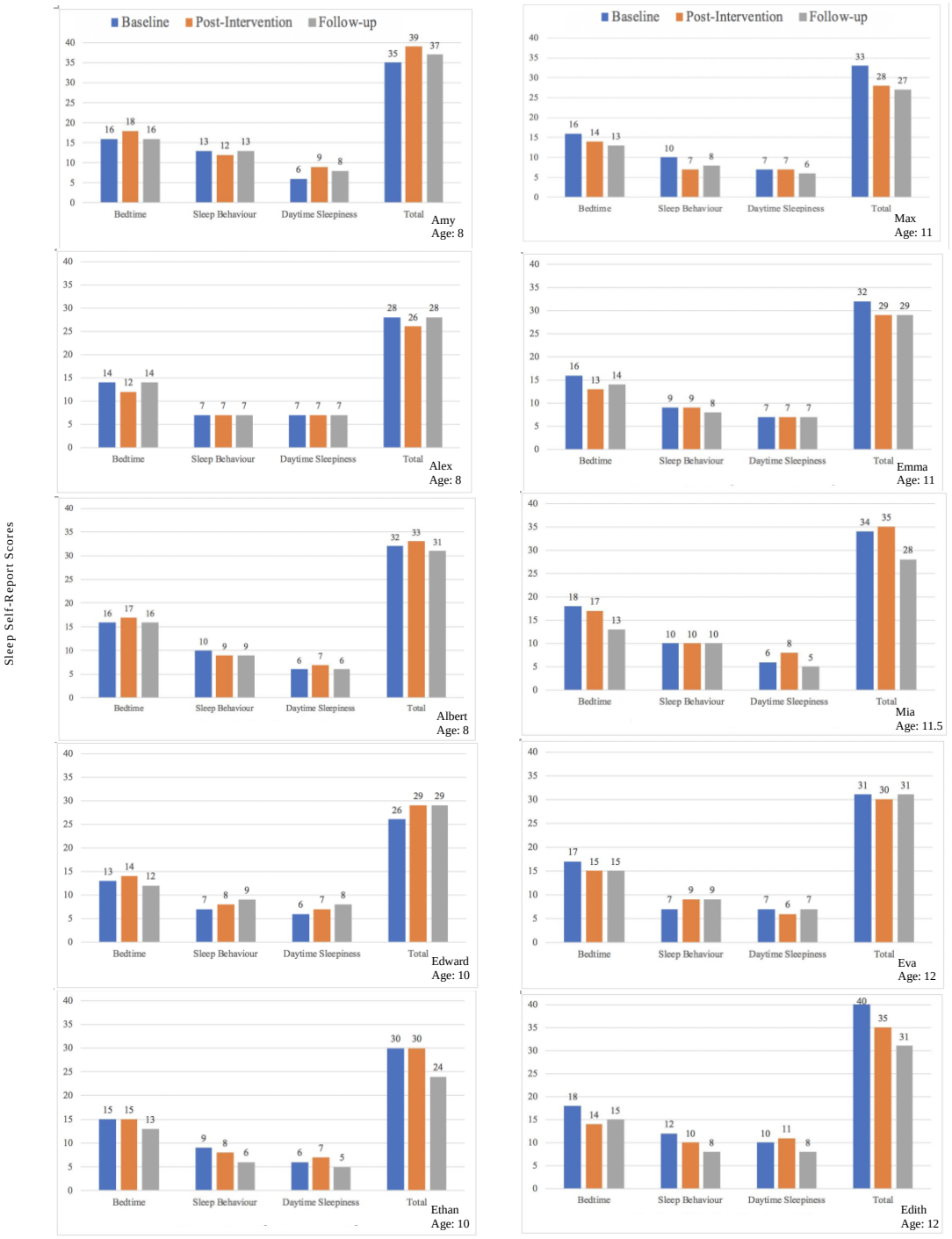

Figure 66. Participants' Sleep Self-report scores. Higher scores indicate more problems.

overall sleep problems at follow-up, while four children (Ethan, Max, Mia and Edith) reported fewer Daytime Sleepiness problems. One child (Edward) reported more sleep problems post-intervention and at follow-up.

Of the three children who partially engaged in the YIC programme (Liberty, 2018), one child reported fewer overall sleep problems and fewer sleep problems at Bedtime after sleep education (Alex); these improvements were not maintained at follow-up. Albert and Amy reported fewer sleep problems with sleep behaviour post-intervention, yet the improvements were not maintained at follow-up. No improvements were reported in children's Daytime Sleepiness scores.

Working memory accuracy and strategy. Figure 67 shows children's Spatial Working Memory Task (SWM) scores with lower scores indicate fewer errors and improved strategy use. Of the seven children who fully engaged in the YIC programme (Liberty, 2018), improvements in working memory accuracy and strategy were observed in three children after sleep education (Ethan, Emma, and Edith); however, the improvements were not maintained at follow-up. Two children showed improvements in working memory accuracy (Edward and Eva), and the improvements were maintained for one child at follow-up (Edward). Improvements on working memory strategy were found in two children (Max and Mia) following the YIC programme, and the gains were maintained for one child (Max) at follow-up.

Of the three children who partially engaged in the YIC programme (Liberty, 2018), one child (Alex) showed improvements in working memory accuracy post-intervention; however, the improvement was not maintained at follow-up. Improvements on working memory strategy were found in Amy and Albert following the YIC programme, and the gains were maintained for both of them at follow-up.

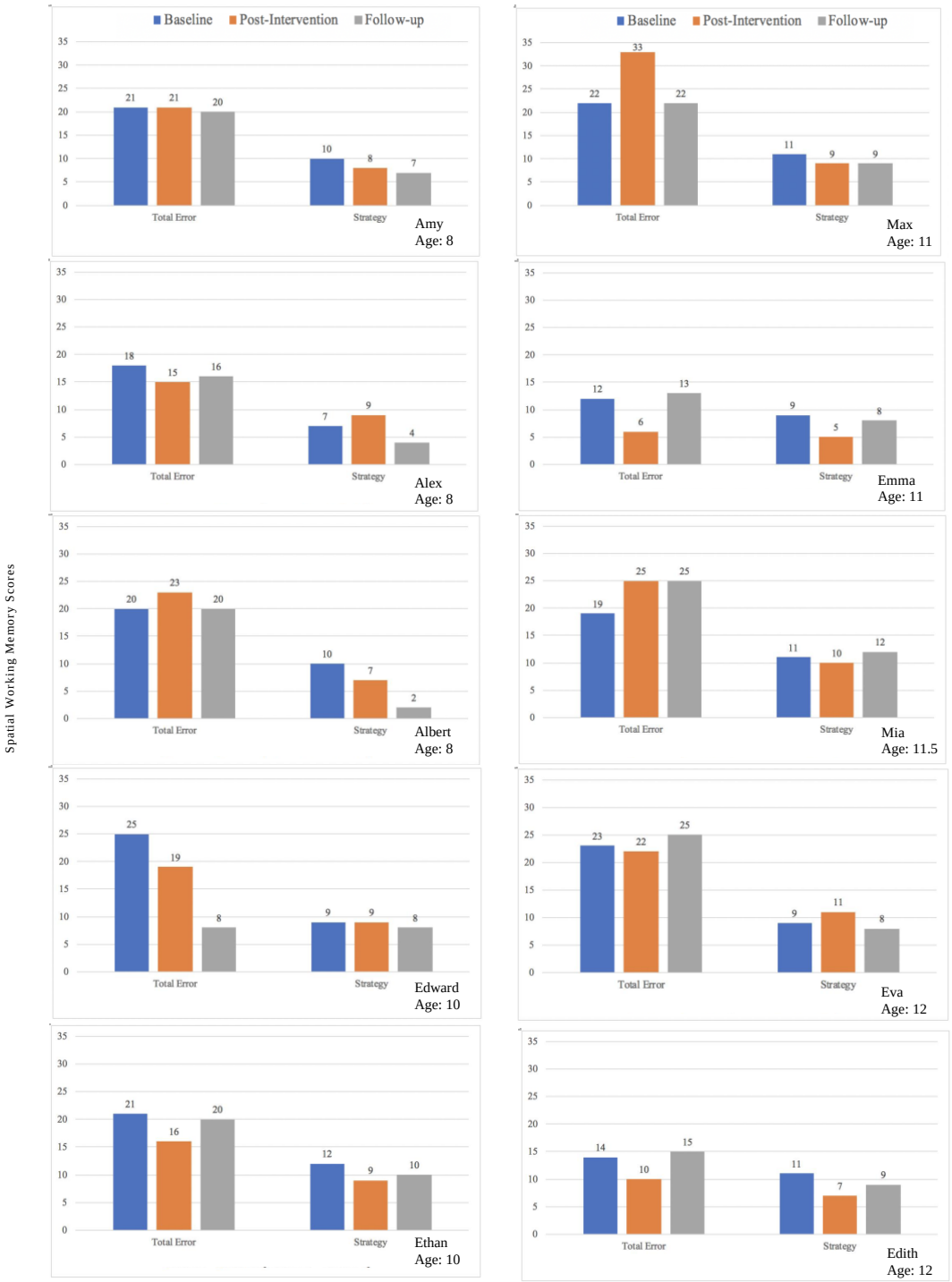

Figure 67. Children' Spatial Working Memory Task scores. Lower scores indicate fewer errors and improved strategy use.

Figure 68. Children' Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition.

Emotion recognition accuracy and speed. Figure 68 shows children's Emotion Recognition Task scores. Higher scores indicate higher accuracy of emotion recognition. Of the seven children who fully engaged in the YIC programme (Liberty, 2018), five showed

improvements in overall emotion recognition accuracy after sleep education (Ethan, Edith, Eva, Emma, and Max); these improvements were maintained for two children (Ethan and Eva). One child showed improvement at follow-up only (Mia). No overall improvement in accuracy was observed in one child's results. Three children showed improvements in emotion recognition speed (Edward, Max and Emma) after sleep education; this was maintained for one child (Edward).

No improvements in overall emotion recognition accuracy were observed in the three children who partially engaged in the YIC programme (Liberty, 2018). Emotion recognition speed was found in two of them (Amy and Albert); the improvements in speed were maintained for both of them at follow-up.

Social validity. All teachers from the six classes with study children provided feedback on the YIC programme (Liberty, 2018). Information regarding the delivery of the programme has been described in the previous Chapter.

Following their implementation of the programme, teachers indicated that the programme had been valuable and engaging. All children in their classes enjoyed the programme. Children in the lower year levels (year 3/4) were more engaged with their parents in sharing sleep knowledge from the YIC programme, whereas children in the higher year levels (year 5/6 and year 7/8) were more engaged in exploring and discussing their bedtime routines. On the other hand, teachers of the children in the lower year levels stated that the programme level was difficult for some children, and the completion and return of sleep slips were poor (sleep slips were part of the YIC programme, and these comments do not refer to the sleep diaries used by study children). Teachers of the children in the higher year levels reported higher sleep slips returns and better sleep goal-setting engagement.

Inter-participants analysis. Table 1 summarizes the mean and standard deviations across experimental phases. Overall, after the sleep education, children reported spending more time in bed. However, the improvement was not maintained at follow-up. Children reported feeling refreshed on more mornings yet feeling drowsy on more mornings too. More often, children reported feeling OK during the day, and they felt moody or grumpy on fewer days. These changes were partially maintained at follow-up. The SSR scores decreased slightly, indicating fewer reported overall sleep problems, fewer bedtime sleep problems, and fewer sleep behaviour problem after sleep education. However, children reported more daytime sleepiness problems. These changes were maintained at follow-up. After the sleep education, the SWM strategy score improved while accuracy remained about the same. The overall accuracy for facial emotion recognition was about the same as baseline, and so was the overall reaction time. These results were consistent at follow-up.

Table 1: *Mean (SD) of Experimental Variables across Experimental Phases [calculated from the means of each participant]*

Variable	Total			Partial engagement			Full engagement		
	A Mean (SD)	B_1 Mean (SD)	B_2 Mean (SD)	A Mean (SD)	B_1 Mean (SD)	B_2 Mean (SD)	A Mean (SD)	B_1 Mean (SD)	B_2 Mean (SD)
Repeated measures									
Time in bed minutes									
per night	612.74	632.96	617.49	681.86	714.92	672.29	583.12	609.55	590.09
	(75.21)	(67.21)	(73.57)	(37.25)	(43.72)	(44.45)	(67.90)	(53.16)	(71.89)
per school night	635.22	638.90	633.13	691.47	716.25	680.5	611.11	616.8	606.58
	(65.81)	(70.72)	(66.10)	(33.94)	(47.73)	(50.20)	(62.08)	(61.03)	(72.11)
Mornings feeling % of mornings									
Refreshed	32	37	38	43	64	62	28	30	27
	(24)	(38)	(29)	(14)	(10)	(16)	(27)	(40)	(28)
Drowsy	51	56	55	43	29	24	54	64	71
	(23)	(36)	(32)	(14)	(0)	(8)	(26)	(38)	(27)
Exhausted	17	6	7	14	7	14	18	6	3
	(21)	(14)	(15)	(25)	(10)	(25)	(21)	(16)	(7)
Days feeling % of days									
Amazing	11	11	26	10	43	62	11	2	8
	(17)	(20)	(29)	(16)	(20)	(16)	(18)	(6)	(9)
Good	40	36	41	52	43	14	34	34	54
	(27)	(31)	(29)	(16)	(0)	(14)	(30)	(35)	(26)
OK	24	38	16	19	7	10	26	47	19
	(21)	(34)	(22)	(22)	(10)	(16)	(21)	(34)	(25)
Moody	19	13	12	14	7	5	21	15	16
	(31)	(14)	(14)	(14)	(10)	(8)	(37)	(15)	(15)
Grumpy	7	2	5	5	0	10	8	2	3
	(18)	(5)	(10)	(8)	(0)	(16)	(22)	(5)	(7)

Variable	Total			Partial engagement			Full engagement		
	A Mean (SD)	B_1 Mean (SD)	B_2 Mean (SD)	A Mean (SD)	B_1 Mean (SD)	B_2 Mean (SD)	A Mean (SD)	B_1 Mean (SD)	B_2 Mean (SD)
Intermittent measures									
SSR Total	32.1 (3.87)	31.5 (3.89)	29.5 (3.41)	31.67 (3.51)	32.67 (6.51)	32 (4.58)	32.29 (4.27)	31 (2.77)	28.43 (2.44)
SSR Bedtime	15.9 (1.60)	14.9 (1.91)	14.1 (1.37)	15.33 (1.15)	15.67 (3.21)	15.33 (1.15)	16.14 (1.77)	14.57 (1.27)	13.57 (1.13)
SSR Sleep Behaviour	9.4 (2.07)	8.9 (1.52)	8.7 (1.89)	10 (3)	9.33 (2.52)	9.67 (3.06)	9.14 (1.77)	8.71 (1.11)	8.29 (1.25)
SSR Daytime Sleepiness	6.8 (1.23)	7.7 (1.42)	6.7 (1.16)	6.33 (0.58)	7.67 (1.15)	7 (1)	7 (1.41)	7.71 (1.6)	6.57 (1.27)
SWM Total Error	19.5 (3.98)	19 (7.72)	18.4 (5.40)	19.67 (1.53)	19.67 (4.16)	18.67 (2.31)	19.43 (4.79)	18.71 (9.12)	18.29 (6.47)
SWM Strategy	9.9 (1.45)	8.4 (1.71)	7.8 (2.90)	9 (1.73)	8 (1)	4.33 (2.52)	10.29 (1.25)	8.57 (1.99)	9.29 (1.38)
ERT Overall accuracy rate %	57 (12)	56 (14)	53 (17)	53 (8)	46 (14)	40 (19)	58 (13)	61 (13)	59 (14)
ERT Anger accuracy rate %	31 (19)	30 (18)	32 (25)	26 (19)	14 (14)	15 (11)	33 (20)	37 (15)	39 (26)
ERT Disgust accuracy rate %	32 (14)	29 (18)	28 (14)	33 (8)	29 (22)	18 (16)	32 (17)	28 (19)	33 (11)
ERT Fear accuracy rate %	20 (15)	24 (21)	17 (18)	16 (16)	11 (12)	6 (5)	22 (16)	30 (22)	22 (20)
ERT Happiness accuracy rate %	54 (23)	54 (16)	53 (19)	46 (13)	45 (11)	39 (21)	58 (26)	57 (18)	59 (16)
ERT Sadness accuracy rate %	31 (23)	36 (29)	27 (20)	19 (23)	15 (11)	23 (19)	36 (22)	45 (29)	28 (22)
ERT Surprise accuracy rate %	48 (15)	49 (17)	48 (26)	50 (19)	35 (18)	32 (23)	47 (15)	54 (13)	55 (26)
ERT overall reaction time	1.43 (0.40)	1.43 (0.41)	1.22 (0.36)	1.89 (0.42)	1.86 (0.16)	1.15 (0.45)	1.24 (0.18)	1.24 (0.34)	1.25 (0.34)

Chapter Five Discussion

The current study evaluated the effects of the *Yes I Can! Sleep Education Programme* (Liberty, 2018) on children's sleep, working memory and emotion recognition. The minimum level of engagement required to be included in the study was for children to attend classes in the Sleep Inquiry learning period. The partially engaged children may have attended classes and produced written work in the *Sleep Inquiry Books* (liberty, 2018), but may have neglected to set their own goals or missed components of the programme, such as recording their own sleep using the sleep slips during the Sleep Scientist learning period. The fully engaged children may have attended classes during both the Sleep Inquiry learning period and the I Am A Sleep Scientist learning period and produced written work in both workbooks. They may have also set sleep goals, but some may not achieve the sleep goals. As a result, seven children fully engaged in the YIC programme, and three partially engaged.

The results showed that the YIC programme had overall positive effects on children's sleep, working memory and emotion recognition. The impacts of the programme were individual-specific, and some of these positive effects appeared to reflect exposure to treatment. More children in the full engagement group showed more stabilized time in bed, reported fewer overall sleep problems, demonstrated better performances on the working memory task and the emotion recognition task. The following sections discuss the effects of the YIC programme on each variable measured in the study. These are: time in bed, feelings on awakening, feelings during the day, self-reported sleep problems measured by SSR questionnaire, working memory accuracy and strategy, and emotion recognition accuracy and speed. The results are discussed in the two subgroups, based on the exposure to the intervention, specifically, children who fully

engaged in the programme (Max, Mia, Edward, Ethan, Emma, Eva and Edith) and children who partially engaged in the YIC programme (Amy, Alex, and Albert).

Time In Bed

The current study presented mixed results in understanding the effects the YIC programme (Liberty, 2018) had on improving children's sleep duration – measured as in time in bed. In terms of improving the time spent in bed, three children (Edward, Ethan, and Max) from the full engagement group and two children (Amy and Albert) from the partially engaged group reported spending more time in bed after sleep education, whereas the rest children did not. These findings are consistent with the reports from Blunden et al.'s meta-analytic study (2012) and Busch et al.'s analytic study (2017), in which the authors indicated that the literature for sleep education programmes often generated mixed results on sleep duration. This was also in line with the findings of studies reviewed in Chapter Two. Six of the eleven studies reviewed in Chapter Two reported improved sleep duration by fourteen to 30 minutes (Maeda et al., 2019; Mindell et al., 2016; Rey et al., 2020; Schlarb et al., 2018; Tamara & Tanaka, 2014; Willgerodt et al., 2014). On the other hand, Gruber et al. (2016) and Paine and Gradisar's (2011) all reported no improvement in sleep duration.

The current study compared children's time in bed with the recommended time for their age group, and it provided further insights in understanding the increased time in bed for each child. Of the seven children who were fully engaged in the YIC programme, two slept the recommended time during baseline, and this did not change after sleep education. Five (Edward, Ethan, Max, Mia and Edith) had one or more nights of sleep duration below the age-appropriate recommended time during baseline. After sleep education, three children had improved on this so that they were sleeping within the recommended time every night. These three children

(Edward, Ethan, and Max) also showed improvements in sleep duration, measured as time in bed, after sleep education. Of the remaining two children, one (Mia) still showed insufficient sleep duration on one of the nights after sleep education; however, compared with baseline, the sleep duration on this insufficient night was much closer to the recommended time for her age, and this child showed a delayed improvement in time in bed during follow-up. It is possible that for this particular child, the YIC programme showed a delayed effect in improving her time in bed. For the one child (Edith) who still spent less than the recommended time in bed on multiple nights post-intervention, her sleep duration did not improve either. A possible reason why Edith's sleep duration did not change could be the incomplete data reported. Edith only reported four of seven nights of time in bed in the week of the post-intervention data collection period, during which she slept sufficient time on two nights. A comprehensive understanding as to what happened to her sleep duration was lacking.

Of the three children who were partially engaged in the YIC programme, they all spent the recommended time in bed during baseline. After sleep education, two (Amy and Albert) of these children's time in bed improved, whereas the other child's post-intervention data was not available. The improved time in bed regardless of the already within recommended sleep duration might reflect the difference of the full engagement group and partially engaged group, as the latter did not engage in studying their own sleep and reflect the sleep knowledge with their sleep (the I Am A Sleep Scientist learning period). It is likely that these children were not aware that they were sleeping the recommended time, hence feel a need to improve sleep duration.

In addition, the YIC programme appeared to have some effects in stabilizing children's time in bed. Of the seven children who fully engaged in the YIC programme, five (Edward, Ethan, Max, Mia and Edith) showed more stabilized time in bed across nights after sleep education.

This indicates that perhaps for children who have already slept the recommended time for their ages, the benefits of the YIC programme in relation to sleep duration would be more likely to manifest from other aspects of sleep, for example, in the case of the current study, more stabilized sleep duration across nights.

On the other hand, none of the children in the partially engaged group showed more stabilized time in bed after sleep education. This might be a relevant difference to their engagement in the YIC programme due to the lack of studying their own sleep.

None of the studies reviewed in Chapter Two compared children's sleep duration with the recommended time for their age group. Of the studies mentioned above, in which sleep duration gain was reported, children in two studies were already sleeping the recommended time for their ages during baseline before the intervention (Mindell et al., 2016; Rey et al., 2020). Maeda and colleagues' study (Maeda et al., 2019) and Willgerodt et al. (2014) did not state whether children were sleeping the recommended time after the intervention despite the improved sleep duration.

Feelings on Awakening

The YIC programme showed positive effects on improving some children's feelings on awakening. Three children (Max, Edward, and Emma) from the full engagement group and two children (Amy and Albert) from the partially engaged group reported improved feelings on awakening after sleep education; one child (Alex) reported improved feelings on awakening during follow-up only (this child lost his post-intervention data). These results were consistent with Tamura and Tanaka's (2014) findings, in which they reported that the number of participants having negative feelings in the morning significantly decreased following the sleep education.

Tamura and Tanaka's (2014) study found that the association between sleep duration and mood in the morning was not significant. Instead, the mood in the morning was significantly associated with bedtime and wake-up time. The results in the current study partly support this. All three children (Max, Edward, and Emma) in the full engagement group who reported improved feelings on awakening worked on their sleep goals of regularising bedtime and wake-up time. Emma's sleep goal was about going to bed and wake-up at the same time every day, and she achieved her goal. Edward's goal was related to regulating wake-up times, which he achieved too. Max's goal was related to regulating bedtime, which according to Max, he did not achieve. Nevertheless, no improvements were found in feelings on awakening for the other three children (Mia, Eva and Edith) in the full engagement group after sleep education, and their sleep goals were relevant to regulating bedtime too. Eva and Edith also achieved their goals. Furthermore, it is possible that the three children in the partially engaged group might also exhibit more consistent bedtime and wake-up time after the sleep education, for Alex's case, during follow-up. However, as bedtime and wake-up time were not included in the current analysis, and these three children did not set sleep goals, it is unknown whether their improved feelings on awakening were relevant to bedtime and wake-up time.

Feelings During the Day

The YIC programme demonstrated positive effects on improving some children's feelings during the day. Improved feelings during the day were reported by two children (Max and Edith) in the full engagement group following the YIC programme and one child (Edward) during follow-up. Two children in the partially engaged group also reported improved feelings during the day. One child (Amy) reported improved feelings after sleep education, and the other (Alex) reported improved feelings during follow-up (this child lost his post-intervention data).

These findings were in line with Tamura and Tanaka's (2014) results, where children in the intervention group reported less irritability during the day after sleep education (41.7% to 26.4%).

Tamura and Tanaka (2014) established a significant association between earlier bedtime and improved daily irritability in their study. The results of the current study partly supported their finding. Both Max and Edith worked on their sleep goals on regulating bedtime, and their reported feelings during the day improved after sleep education. However, although reported not achieved, Mia also worked on her goal of regulating bedtime. For similar reasons previously discussed under feelings on awakening, it is not clear whether Amy and Alex's improved feelings during the day would support Tamura and Tanaka's (2014) finding.

Nevertheless, no improvements in feelings during the day were found in the other four children in the full engagement group (Emma, Eva, Mia and Ethan; Ethan's follow-up data was missing). Of them, Emma and Eva reported generally positive feelings across all phases, which might explain the lack of further improved feelings during the day.

Reported Sleep Problems – SSR Scores

The YIC programme showed positive effects in reducing children's overall self-reported sleep problems; this was particularly relevant for children in the full engagement group. Four (Max, Eva, Emma, and Edith) reported fewer overall sleep problems after sleep education, as shown in the reductions of their SSR total scores. At follow-up, two more children (Ethan and Mia) showed delayed improvements in overall sleep problems. Edward was the only child in this group who reported more sleep problems after sleep education. On the other hand, only Alex in the partially engaged group reported fewer overall sleep problems after sleep education;

Amy's and Albert's SSR Total scores increased post-intervention, indicating more reported sleep problems.

The differences in overall reported sleep problems might be explained by the differences in children's exposure to treatment. The SSR questionnaire measured children's reported sleep problems using items reflective of sleep behaviours. Perhaps for change in the sleep behaviours to occur, practice and rehearse are essential in addition to the adequate sleep knowledge gained during the Sleep Inquiry learning period. During the learning period of *I Am A Sleep Scientist Book*, children learned to explore their sleep behaviours, set goals for specific sleep behaviours and practice the specific sleep behaviours as a part of their goal setting and achieving practice. Children who partially engaged in the programme might not necessarily be engaged in this process; as a result, their overall reported sleep problems would remain high.

Nonetheless, the improved overall self-reported sleep problems observed in most children in the full engagement group were similar to findings stated in Hiscock and colleagues' study (2015) and Schlarb et al.'s (2018) studies. Both studies found a reduction in sleep difficulties/sleep disturbance measured by SSR total scores among children in the intervention group following the CBT sleep interventions used in their studies. Both studies reported large effect sizes (Hiscock et al. (2015): d = 1.28; Schlarb et al., (2018) post d = 0.81, follow-up d = 1.28).

Sleep Behaviour – Changes in SSR Items

Improved sleep behaviours following the YIC programme, as measured by items on the SSR questionnaire, appeared to be individual specific. After sleep education, all children in the full engagement group but Edward showed improvements in some SSR items. Max fought less often with parents "about going to bed"; he was less likely to "stay-up late"; he did not "wake-up at

night" anymore; and it was easier for him to "go back to sleep if wake up during the night". Mia did not "fight with parents about going to bed"; it was easier for her to "go to be" and she was less "afraid of the dark". Ethan also stopped "fighting with parents about going to bed"; he did not feel that he slept "too little"; and it was easier for him to "falling back to sleep if wake up during the night". Emma always fell "asleep in about 20 minutes"; and she was less "afraid of the dark". Eva went "to bed at the same time every night on school nights"; she stopped fighting with parents about "going to bed"; and she was often "ready for bed at the usual bedtime". Edith went to bed "at the same time every night on school nights"; she found it easier "to go to bed"; she was already "ready for bed at the usual bedtime"; she "stayed up late" less often; she did not think she "sleep too much", and it was easier for Edith to "fall back to sleep if wake up during the night".

Improvements were reported by all children from the partially engaged group after sleep education, and these changes were individual specific. Amy went to bed "at the same time every night on school nights"; and she stopped fighting "with your parents about going to bed". Alex found it easier for him to "go to bed"; and that he was usually "ready for bed at his usual bedtime". He also reported not "waking up at night" anymore. Albert found it easier to "go to bed"; he "stayed up late" less often; and he "woke up at night" less often.

The current study was able to show the changes in sleep behaviours beyond the changes in the SSR scores using the SSR questionnaire items. It demonstrated that the YIC programme's effect on improving children's general sleep behaviours might be individual specific and relevant to what they considered essential to their sleep.

One of the YIC programme's critical features was that children learned to monitor and study their sleep using the *I Am A Sleep Scientist Book*. This, together with the *Sleep Inquiry Book*,

built a foundation and acted as a reference to good sleep behaviour practice for children. Some children might identify the inadequate sleep behaviours currently being practised and decided to modify them regardless of the target sleep goals. Some children might recognise some poorly practised sleep behaviours that prevented them from achieving the sleep goal; thus, these sleep behaviours were improved as well.

Sleep education programmes built on motivational self-help concepts showed comparable results regarding sleep behaviours. Willgerodt and colleagues' study (Willgerodt et al., 2014) reported children's sleep behavioural changes on top of achieving target sleep behaviours following the motivational-based sleep intervention. According to parents' qualitative feedback, these behaviours included: stabilized bedtime, earlier bedtime, and children's sleep awareness. Similar findings were reported in Tamura and Tanaka's study (2014). The authors found significant improvement in regularised wake-up time and elimination of napping among children in the intervention group after the self-help sleep education programme. One reason that other sleep behaviours improved with the targeted sleep goal might be relevant to what described by Busch and colleagues (Busch et al., 2017) as the 'transfer of learning' principle, in which children are able to apply strategies and skills to a new context. It is possible that children might apply the strategies in assisting them in achieving their sleep goals to other sleep behaviours, resulting in positive changes in other sleep behaviours.

On the other hand, the YIC programme showed limited effects in improving some sleep behaviours, including items related to daytime sleepiness on the SSR questionnaire. After sleep education, only one child from the full engagement group reported fewer problems with daytime sleepiness, as indicated by reducing SSR Daytime Sleepiness subscale score. None of the children in the partially engaged group reported improved daytime sleepiness problems. These

results were consistent with findings reported in Tamura and Tanaka's study (2014). The authors found no significant difference in the proportion of children's self-reported sleepiness after the intervention (59.7% Vs 52.8%). Furthermore, Tamura and Tanka's (2014) study found no significant difference in sleepiness between children in the intervention and control groups. The lack of impact on daytime sleepiness was also consistent with Busch et al.'s (2017) and Blunden et al.'s (2012) meta-analyses, where they suggested that sleep education programmes were less successful in changing daytime sleepiness.

Self-determined Sleep Behaviour – Sleep Goal

The *Yes I Can! Sleep Education Programme* (Liberty, 2018) showed effectiveness in changing children's self-determined sleep behaviour as shown in sleep goal engagement. Of the seven children who fully engaged in the programme, all set sleep goals, and five achieved their goals. Four of these five children continued practising the same sleep goals during the follow-up period, indicating a sustained positive effect in sleep behaviour change. This showed that children can take agency of their sleep and develop pathways to achieve self-determined sleep goals, which generated sleep behaviour change. Similar results were reported in Willgerodt and colleagues' (Willgerodt et al., 2014) motivational-based sleep intervention study, in which all target sleep behaviours that were co-decided by children and the parents such as earlier bedtime, no intense play before bed, and no co-sleeping were achieved. Students in Tamura and Tanaka's study (2014) adopted a similar approach in setting a sleep goal for a specific target sleep behaviour. However, the comparison of results to the current study was not available because the authors did not report individual results regarding goal-achieving.

On the other hand, three children did not set sleep goals. Two of them (Amy and Albert) had been absent from school due to either sickness or spending time overseas. As a result, both

had missed many classes during the *I Am A Sleep Scientist* (Liberty, 2018) learning period. This might be one of the reasons for not engaging in goal settings. The other child's teacher told the study researcher that Alex was reluctant in engaging any written works, which affected his participation in the YIC programme especially during the *I Am A Sleep Scientist* (Liberty, 2018) learning period. As a result, he might not be willing to study his sleep and set a sleep goal.

Working Memory - Accuracy and Strategy

The current study results showed that the YIC programme (Liberty, 2018) had a positive impact on improving children's working memory. All children in the full engagement group showed either improved working memory accuracy or working memory speed, so did the three children in the partially engaged group.

Sleep intervention studies that include measures of cognition in children are scarce. Rey and colleagues' (Rey et al., 2020) study was the only study in the review to measure executive functions when evaluating their sleep education programme. They measured inhibitory control, cognitive flexibility, mental planning, running span, sustained attention, memory recognition, and a global score, all of which improved after sleep education except for memory recognition.

The literature on working memory and sleep has mainly focused on exploring the deficit relationship between specific sleep variables and worsened performance on working memory tasks using quantitative studies. These sleep variables include poor sleep quality, shortened sleep duration, poor sleep efficiency and prolonged sleep onset latency (Könen, 2015; Kopasz et al., 2010). The current study took a positive approach and suggested that working memory task performances could possibly be enhanced following sleep education.

Emotion Recognition – Accuracy and Speed

The results of emotion recognition accuracy of children who fully engaged in the programme differed from those who partially engaged. Improvements in overall emotion recognition accuracy were observed in five children (Ethan, Edith, Eva, Emma, and Max) in the full engagement group after sleep education, whereas none of the children in the partially engaged group showed improvements. Mia showed a delayed improvement in the overall emotion recognition accuracy at follow-up. No improvement in Edward's performance on accuracy was reported. Three children in the full engagement group showed improvements in emotion recognition speed (Edward, Max and Emma) after sleep education, whereas Amy and Albert from the partially engaged group reported improvements. However, as Amy's and Albert's emotion accuracies did not improve, it is possible that the speed gains are not reflective of true improvements in emotion recognition. Therefore, it is possible that the group differences in emotion recognition accuracy might be relevant to programme engagement.

The overall improvement in emotion recognition is in line with Rey et al.'s (2020) study, where overall executive functions, including inhibitory control, improved. No studies of sleep intervention included measures of facial emotion recognition to the best of the author's knowledge, making the comparison of results difficult. However, the high frequency of night-waking and poor sleep efficiency has been associated with poor performance in facial emotion recognition task in 94 ten-year-old healthy children (Soffer-Dudek et al., 2011). Although children in the current study reported waking up in the night and having trouble falling back to sleep, emotion recognition results are not in line with Soffer-Dudek and colleagues' finding (Soffer-Dudek et al., 2011).

Strengths and Limitations

Studies of sleep education programmes conducted on school-aged children are scarce, even fewer, with single-subject designs. The current study utilized single-subject design, which allowed comprehensive analysis on each child. Individual children's sleep patterns, sleep behaviours, sleep problems and aspects of cognition are explored and examined as a whole in relation to the YIC programme. Given the varied and complicated nature of children's sleep problems, a single-subject design appeared most suitable for the current study.

The specific sleep behaviours were studied in relation to the YIC programme. Including the measures of specific sleep behaviours was essential because specific sleep behaviours are likely to be relevant to children's reported sleep problems and reflect children's sleep. It also allows the study author to examine the possible impact of a sleep education programme on particular sleep behaviours. Few studies reported the effect of a sleep education programme on specific sleep behaviours. In the current literature review, only Tamura and Tanaka (2014) reported specific sleep behaviour change, where most studies reported change in scores only.

The current study compared children's time in bed with the recommended age-appropriate sleep duration as a reference to sufficient sleep when evaluating the YIC programme's impact, which none of the studies reviewed in Chapter two did. In the current study, although most children's time in bed improved after sleep education, these children had already been spending the recommended time in bed for their ages during baseline. Perhaps merely focusing on sleep duration gain was not an effective way to evaluate the effects of the sleep education programme.

Finally, working memory and facial emotion recognition tasks were included in the current study as measures of children's executive functions in relation to the YIC programme. It

expanded cognition domains measured in Rey et al.'s study (2020) and added valuable insights to the literature on the sleep education programme.

One of the major limitations of this study is that three children did not set sleep goals, although they completed the *Sleep Inquiry Book*. Of the three, one child was overseas; the other child was sick; both were away for a lot of the classwork during Sleep Scientist learning period. The other child's teacher told the study researcher that this child was not keen on written work, that might be one of the reasons why he did not set sleep goals. Another possible explanation could be age. The YIC programme is initially developed for children between nine and twelve (Liberty, 2018). All three children who did not fully engage in the programme were eight at the study time. According to the feedback provided by the teachers of these children, "the levels (of the YIC programme) was too difficult for some children", and "It was difficult to engage children to complete sleep slips". Teachers with older children did not otherwise report these comments.

There are a few methodological issues in this study, some of which are relevant to the single-subject design, for example, internal and external validity. Sleep diaries of seven nights were used as children's baseline sleep measure. An extended period of baseline, for example, two weeks, would strengthen the study's internal validity. Alternatively, the introduction of a multiple baseline design would also enhance the controlling effects of the YIC programme (Cooper et al., 2007). However, school A incorporated the YIC programme within regular school hours with a tight school term schedule. For that reason, an extended period of baseline measure or applying multiple baseline design was not possible. In the single-subject design, external validity is established by replicating desired changes across participants (Cooper et al., 2007). In the current study, not all children were engaged fully in the YIC programme, hence

their results were presented and discussed based on the exposure of treatment, in this case, the seven children who fully engaged in the YIC programme (Liberty, 2018), and the three children who partially engaged in the programme. It might comprise the external validity of the study.

In addition to the limitations associated with the single-subject design, there are other methodological issues in the current study. Although the BEARS questionnaire was used as a screening tool for sleep problems, it contains valuable information regarding children's sleep that is individual specific. A follow-up measure of the BEARS questionnaire to the study children and their parents will provide vital insights into the study. Secondly, another follow-up period should be applied to assess children's long-term sleep gain due to the YIC programme. Thirdly, the current study did not adopt an objective measure of sleep knowledge. Instead, sleep knowledge was measured by having the study researcher checking children's work in *the Sleep Inquiry Book* and the *I Am A Scientist Book*. An objective measure of sleep knowledge would allow a more detailed exploration of the association between sleep knowledge and other sleep parameters, especially sleep behaviour. It would also enable the study research to assess children's knowledge gain after the YIC programme. Fourthly, given the small number of participants in the current study, the introduction of an objective measure of sleep, for example, actigraphy, would be a helpful addition to the sleep diary. Finally, all sleep reports used in the current study are from children's self-report. No official feedback or questionnaire about children's sleep change was administered to their parents. According to the teacher's feedback, many children shared and discussed sleep knowledge acquired from the YIC programme at home with their parents. Measuring parents' sleep knowledge gain and parents' perception change about children's sleep behaviours/sleep problems would provide valuable analysis to the current study.

There are a few issues associated with data collection. Although sleep diaries have been established as a reliable measure of sleep and are widely used in studies involving children, data returning had been an issue in the current study. The current study used the sleep slips from the YIC programme (Liberty, 2018) that children were already familiar with as sleep diaries to minimize any confusion or difficulties children might encounter in completing the sleep diaries. However, some children forgot to record their sleep for one measurement period; an alternative school week of measurement period had to be arranged for sleep data recording. One child lost the entire set of completed sleep diaries for one measurement period. Some children often forgot when they woke in the morning or how they felt in the morning; hence the sleep data was incomplete.

There are some limitations associated with the current study results. Firstly, because some study children were not engaged fully in the YIC programme, in other words, the ten study children were not exposed to the same treatment, children's results were presented and discussed in two groups: the full engagement group, and the partially engaged group. It limited the possible interpretation of some results. For example, children's feelings on awakening and feelings during the day. Secondly, the time in bed for the one child who did not sleep the recommended time on multiple nights during baseline, did not improve after sleep education. Similar patterns were observed in two of the four children who achieved sleep goals but showed less regulated sleep patterns during baseline. Finally, the current study did not include analyses of children's wake-up time and bedtime. Although these data were collected, they were mainly used to calculate children's time in bed. Given bedtime and wake-up time have been studied and contributed promising results in Tamura and Tanaka's (2014) study, including the analyses of wake-time and bedtime would have been a desirable addition to the current study.

The current study revealed that the YIC programme was less effective in changing some sleep behaviours other than children's self-determined sleep goals. This supports Busch et al.'s (2017) and Blunden et al.'s (2012) views that sleep education programmes appeared to be less effective in improving sleep behaviours in general. However, as discussed previously, the study results show that sleep education programmes positively impact changing self-determined sleep behaviours while changes in other sleep behaviours might be individually specific.

Due to the current study's scale, the literature on sleep problems and symptoms of Post-Traumatic Stress Disorder, the association of sleep and working memory, the relationship of sleep and emotion recognition have not been investigated thoroughly. These contributed to the limitations in interpreting the study results.

Implications For Practice And Future Research

The current study included ten children for a small study that examined the *Yes I Can! Sleep Education Programme* (Liberty, 2018) on sleep, working memory, and emotion recognition while the school implemented the programme. All children responded well to the instruments. No child reported having difficulties in completing the sleep diaries or the SSR questionnaire. All children showed full concentration while completing the two cognitive tasks using an iPad. Parents' responses to the study were positive. The study research encounters no communication difficulties with parents on the delivery and collection of sleep diaries from children's home. Support from the school was immense. Teachers all provided valuable feedback on the sleep education programme and the specific children who participated in the current study. All of the above mentioned demonstrated the feasibility of conducting a small study alongside implementing a major sleep programme in school. It shows that involving the key stakeholders in children's lives strengthens the implementation of the study. Thus, it is recommended for

future studies on sleep education programme to engage children's family, immediate institutions, and groups.

The YIC Sleep Education Programme is created specifically for children in New Zealand with close considerations of ecological factors associated with children's life. The programme is built around key constructs of self-determined learning, including agency, goal setting, pathway thinking and problem solving (Ryan & Deci, 2000). As Busch et al. (2017) established, when children were invited to be actively involved in the decision-making process during the implementation of sleep interventions, their cognitive beliefs in changing specific sleep-related behaviours would be strengthened. Therefore, they are more likely to improve/change their sleep behaviours. This has been supported by the current study and studies adopted other sleep interventions based on the self-help principle. In addition to the in-school programme, the YIC programme involved parents and teachers by providing interactive sleep resources that include sleep experts' participation (website and Facebook group). According to Busch et al. (2017), a sleep education programme based on an ecological approach, employs transfer of learning and includes the parents, and significant adults' participation is likely to have positive impacts on children's sleep. Future sleep education programmes should continue to build on these guidelines.

The importance of age-appropriate sleep has been well established (Bagley & El-sheikh, 2013). Future research should always measure sleep duration against a more objective reference; for example, the culturally appropriate recommended sleep duration for participants' age-group. Although measuring sleep duration gain was most commonly used in studies evaluating sleep interventions, there are limitations in this approach. Not all children are sleep deprived. When involving children whose sleep duration is already within the recommended time range, reports

of further improved sleep duration as a gain from the sleep intervention appear to bear less significance than other primary measures, such as measures of sleep problems. As previously discussed in Chapter one, sleep problems included so much more than merely insufficient time in bed. Inadequate sleep quality, inconsistent bedtime routine, having trouble falling asleep, night-waking, inability to return to sleep, difficulty waking in the morning, experiencing nightmares, snoring, and feeling tired during the day are all common forms of sleep problems (Bagley & El-sheikh, 2013).

Finally, working memory and facial emotion recognition tasks were included in the current study as measures of children's executive functions in relation to the YIC programme. It expanded the aspects of cognition Rey et al., 2020 measured in their study. The results are promising. Other studies reviewed in the current study comprised outcome measures such as academic performance (Ashton, 2017; Gruber et at., 2016) and daily functioning (Tamura & Tanaka, 2014), behavioural problems (Hiscock et al., 2015; Willgerodt et al., 2014) and emotional problems (Hiscock et al., 2015), mental health status (Paine & Gradisar, 2011), and future school refusal behaviour (Maeda et al., 2019). Given the essential role that sleep plays in children's intellectual and emotional development, future studies evaluating sleep education's effects should include outcome variables other than sleep parameters. Nevertheless, the association between sleep variables and cognition aspects in light of sleep intervention is largely unclear. More studies are desirable in this area.

Conclusion

The current study evaluated the effects of the *Yes I Can! Sleep Education Programme* (Liberty, 2018) on children's sleep, working memory and emotion recognition. The results demonstrated that the YIC programme positively impacted changing children's self-determined

sleep behaviours, reduced sleep problems, and elevated children's feeling during the day. Performances on working memory and emotion recognition tasks improved following sleep intervention. The findings of the current study supported Blunden et al.'s (2012) and Busch et al.'s (2017) conclusions that a sleep education programme designed with an ecological approach and involved parents' participation is most successful. Future research should examine the effects of a sleep education programme on cognition, as the results of the current study showed a promising outlook for future research in this area.

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Appendices

Appendix A: Human Ethics Committee Approval

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: 2018/12/ERHEC

4 April 2018

Chao Gu
School of Health Sciences
UNIVERSITY OF CANTERBURY

Dear Chao

Thank you for providing the revised documents in support of your application to the Educational Research Human Ethics Committee. I am very pleased to inform you that your research proposal **"**Effects of the Yes I Can Sleep Education Programme on Childrens' Sleep and Memory" has been granted ethical approval.

Please note that this approval is subject to the incorporation of the amendments you have provided in your emails of 13th and 22nd March 2018.

Should circumstances relevant to this current application change you are required to reapply for ethical approval.

If you have any questions regarding this approval, please let me know.

We wish you well for your research.

Yours sincerely

pp R. Robinson

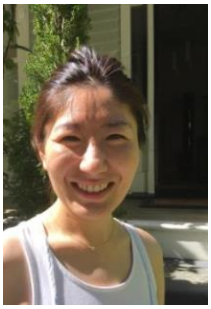
Dr Patrick Shepherd
Chair
Educational Research Human Ethics Committee

Appendix B: Letter and Information Sheet to Principal

Chao Gu
School of Health Sciences, College of Education
University of Canterbury
Private Bag 4800
Christchurch 8140
Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Dear *Principal*



My name is Chao Gu and I am a Masters student in the Child and Family Psychology programme at the University of Canterbury. For my study, I am interested in learning about the effects of the *Yes I Can Sleep Education* programme on children's sleep and memory.

I would like to invite your school and up to 10 of your pupils and their parents and caregivers to participate. Participation involves:

- One teacher of children aged 8-12 consenting to participate. Teacher participation involves sending home approved parent and child information sheets and consent forms to up to 10 of the pupils in their class (copy attached). Parents and caregivers will be asked to return the forms to me; the teacher won't need to collect these. Children should be aged 8-12 years, and lived in Christchurch during the earthquakes in 2010-2013.
- The teacher will also work with me to set a time and place, such as the school library or after school, for a 15-minute memory test for each pupil, and time for them to complete a questionnaire about their sleep, for a total of about 30 minutes (unless the parents and caregivers wish the testing to occur at home). The same testing of the same children will occur before the start of teaching the *Yes I Can programme*, afterwards, and at the start of the following school term. Also, afterwards, with the child's assent, I will take some photos of their work in the sleep education workbooks.

Associate Professors Kathleen Liberty and Karyn France are supervising my study. I hope that the study will help us learn more about children's memory and sleep, so that other children can benefit from this knowledge.

Please email, call, or text me (details above) if you are interested in participating and I will telephone you in the evening to answer any questions you may have and give you more information about the study. Or you can telephone or text my senior supervisor, Kathleen Liberty, on 027 349 0645. Or, you can complete the attached forms and email or call me at the contact details above to come pick them up.

Thank you for your time and consideration,

Chao Gu

Chao Gu
School of Health Sciences, College of Education
University of Canterbury
Private Bag 4800
Christchurch 8140
Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Information Sheet for Principals

My name is Chao Gu and I am a Masters student in the Child and Family Psychology programme at the University of Canterbury. For my study, I am interested in learning about the effects of the *Yes I Can Sleep Education* programme on children's sleep and memory.

I would like to invite you, one or more of your teachers, and up to 10 of your pupils and their parents and caregivers to participate. Participation involves:

- One teacher of children aged 8-12 consenting to participate. Teacher participation involves sending home approved parent and child information sheets and consent forms to up to 10 of the pupils in their class (copy attached). Parents and caregivers will be asked to return the forms to me; the teacher won't need to collect these. Children should be aged 8-12 years, and lived in Christchurch during the earthquakes in 2010-2013.
- The teacher will also work with me to set a time and place, such as the school library or after school, for a 15-minute memory test for each pupil, and time for them to complete a questionnaire about their sleep, for a total of about 30 minutes (unless the parents and caregivers wish the testing to occur at home). The same testing of the same children will occur before the start of teaching the *Yes I Can programme*, afterwards, and at the start of the following school term. Also, afterwards, with the child's assent, I will take some photos of their work in the sleep education workbooks.
- Please also see attached copies of the teacher, parent and child information sheets and consent forms.

If you agree for your school to participate, a consent form is supplied with this letter. If you wish to consent, please sign the form and email the researcher, Chao Gu, so she can come and pick up the form. If you do not wish to consent, do not sign the form. It would be helpful if you emailed to the researcher, Chao Gu, with your decision, but it is not required.

Please note that participation in this study is voluntary and the right to withdraw at any stage without penalty is maintained.

I will take particular care to ensure the confidentiality of all data gathered for this study. I will also take care to ensure anonymity in publications of the findings. The name of the school will not be used. Coded data will only be accessible by me and by my supervisors prior to submission. All the data will be securely stored in password protected facilities and locked storage at the University of Canterbury, and will be destroyed following the study. You are able to request a summary of this study. Data from this study will be published in a thesis and may be published in an academic journal or presented at a conference.

If you require further information, please contact the researcher, Chao Gu (details above) or her supervisor, Kathleen Liberty, on 027 349 0645 or kathleen.liberty@canterbury.ac.nz.

This project has received ethical approval from the University of Canterbury Educational Research Human Ethics Committee. Participants should address any complaints about the study to the Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Thank you for your time and consideration, Chao Gu

Appendix C: Principal Consent Form

Chao Gu
School of Health Sciences, College of Education
University of Canterbury
Private Bag 4800
Christchurch 8140
Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Consent Form for Principal

I have been given a full explanation of this study and have been given an opportunity to ask questions.

I understand what will be required of the school if I agree to take part in this study.

I understand that the school's participation is voluntary and that the school may withdraw at any stage without penalty. It is also understood that if this occurs, all information regarding the school will be removed from the study and destroyed.

I understand that data from this study will be published in a thesis and could be published in an academic journal or presented at a conference. I understand that any information or opinions I provide will be kept confidential to the researcher, Chao Gu, and will not identify me.

I understand that all data collected for this study will be kept in locked and secure storage facilities at the University of Canterbury and will be destroyed upon completion of the project.

I understand that I am able to request a report on the findings of this study.

I understand that if I require further information I can contact the researcher, Chao Gu, or her supervisor, Kathleen Liberty. If I have any complaints I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee.

By signing below I am declaring that I have read and understood the statements above and agree to fulfil my role to allow the completion of this study. If I have provided an email address, I would like to receive a summary of the findings.

Name (please print): _____

Name of School _____

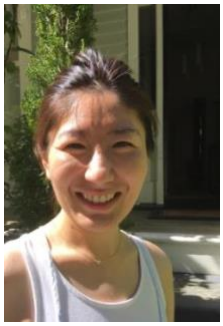
Signature: _____ Date: _____

Email address: _____

Appendix D: Letter and Information Sheet to Teacher

Chao Gu
School of Health Sciences, College of Education
University of Canterbury
Private Bag 4800
Christchurch 8140
Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

Dear *Teacher*



My name is Chao Gu and I am a Masters student in the Child and Family Psychology programme at the University of Canterbury. For my study, I am interested in learning about the effects of the *Yes I Can Sleep Education* programme on children's sleep and memory.

This study has been discussed with the School Principal and BOT, who have given you this letter.

I would like to invite you and up to 10 of your pupils and their parents and caregivers to participate. Participation involves:

- Sending home approved parent and child information sheets and consent forms to up to 10 of the pupils in your class (copy attached). Parents and caregivers will be asked to return the forms to me; you won't need to collect these.
- Children should be aged 8-12 years, and lived in Christchurch during the earthquakes in 2010-2013.
- Working with me to set a time and place, such as the school library, for a 30 minute period to include memory tests and sleep questionnaire for each pupil (unless the parents and caregivers wish the testing to occur at home). This testing of each pupil will occur before you start teaching the *Yes I Can programme*, afterwards, and perhaps in the next school term, depending on when the school completed the Yes I Can programme. Also, afterwards, with the child's assent, I will take some photos of their work in the sleep education workbooks.

Associate Professors Kathleen Liberty and Karyn France are supervising my study. I hope that the study will help us learn more about children's memory and sleep, so that other children can benefit from this knowledge. More information about this study and a consent form are attached.

Please email, call, or text me (details above) if you have questions and I will telephone you in the evening. Or you can telephone or text my senior supervisor, Kathleen Liberty, on 027 349 0645.

Thank you for your time,

Chao Gu

Chao Gu
School of Health Sciences, College of Education
University of Canterbury
Private Bag 4800
Christchurch 8140
Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Information Sheet for Teachers

My name is Chao Gu and I am a Masters student in the Child and Family Psychology programme at the University of Canterbury. For my study, I am interested in learning about the effects of the *Yes I Can Sleep Education* programme on children's sleep and memory.

This study has been discussed with the School Principal and BOT, who have given you this letter.

I would like to invite you and up to 10 of your pupils and their parents and caregivers to participate. Participation involves:
(1). Sending home approved parent and child information sheets and consent forms to up to 10 of the pupils in your class (copy attached). Parents and caregivers will be asked to return the forms to me; you won't need to collect these. Please see attached copies of the parent and child information sheets and consent forms so you can read what is sent to parents and caregivers.
(2). Working with me to set a time and place, such as the school library, for a 30-minute period to include memory tests and a sleep questionnaire for each pupil (unless the parents and caregivers wish the testing to occur at home). The testing will occur before you start teaching the *Yes I Can programme*, afterwards, and perhaps in the next school term. Also, afterwards, with the child's assent, I will take some photos of their work in the sleep education workbooks.

If you agree to participate, a consent form is supplied with this letter. If you consent, please text me above and I can come and pick up your signed form, and bring the information to be sent home to the parents and caregivers.

Please note that participation in this study is voluntary and the right to withdraw at any stage without penalty is maintained.

I will take particular care to ensure the confidentiality of all data gathered for this study. I will also take care to ensure anonymity in publications of the findings. Coded data will only be accessible by me and by my supervisors prior to submission. All the data will be securely stored in password protected facilities and locked storage at the University of Canterbury, and will be destroyed after five years following the study. You are able to request a summary of this study. Data from this study will be published in a thesis and may be published in an academic journal or presented at a conference.

If you require further information, please contact the researcher, Chao Gu (details above) or her supervisor, Kathleen Liberty, on 364 2545 or kathleen.liberty@canterbury.ac.nz.

This project has received ethical approval from the University of Canterbury Educational Research Human Ethics Committee. Participants should address any complaints about the study to the Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Thank you for your time, Chao Gu

Appendix E: Teacher Consent Form

Chao Gu
School of Health Sciences, College of Education
University of Canterbury
Private Bag 4800
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Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Consent Form for Teacher

I have been given a full explanation of this study and have been given an opportunity to ask questions.

I understand what will be required of me if I agree to take part in this study: 1. Send home the information sheets and forms to all the children in my class. 2. Set times for Chao and any participating student to meet for measurement purposes if requested by parent (which can include before or after school).

I understand that my participation is voluntary and that I may withdraw at any stage without penalty. It is also understood that if this occurs, all information regarding myself will be removed from the study and destroyed.

I understand that data from this study will be published in a thesis and could be published in an academic journal or presented at a conference. I understand that any information or opinions I provide will be kept confidential to the researcher, Chao Gu, and will not identify me.

I understand that all data collected for this study will be kept in locked and secure storage facilities at the University of Canterbury and will be destroyed after five years.

I understand that I am able to request a report on the findings of this study.

I understand that if I require further information I can contact the researcher, Chao Gu, or her supervisor, Kathleen Liberty. If I have any complaints I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee.

By signing below, I am declaring that I have read and understood the statements above and agree to fulfil my role to allow the completion of this study. If I have provided an email address, I would like to receive a summary of the findings.

Name (please print): _____

Signature: _____ Date: _____

Email address: _____

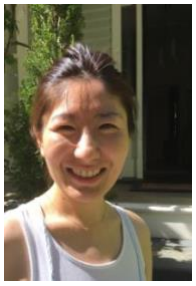
If you consent, please text Chao on 021 459 102 and she text back to set a time to come and pick up your consent form and give you the forms to send home with the children. If you don't consent, please give this form to another teacher in the school or back to your principal.

Appendix F: Letter and Information Sheets to Parents/Caregivers and Child

Chao Gu
School of Health Sciences, College of Education
University of Canterbury
Private Bag 4800
Christchurch 8140
Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Dear *(name of parent to be inserted by teacher)*



My name is Chao Gu and I am a Masters student in the Child and Family Psychology programme at the University of Canterbury. For my study, I am interested in learning about the effects of the *Yes I Can Sleep Education* programme on sleep and memory.

Your child's school and teacher will be teaching your child about sleep using this programme as part of the school curriculum. (For more information about the sleep programme, please contact your child's teacher.)

Your child's teacher has consented to being part of this study, and to sending you this letter with the approval of the school.

You and your child are invited to participate in my study so that I can learn more about how sleep affects memory. Participation involves the following activities at 3 time points: a week before the teaching programme begins, a week after the teaching programme, and a week next term (3 weeks in total).

1. Helping your child complete a brief report on their sleep for 7 nights (8 mornings). This will take less than a total of 5 minutes per day.
2. Your child completing two short tests of memory on an iPad. At most this will take 15 minutes. These tests can be taken at home, if you prefer, or at school.
3. Your child answering 26 questions about their sleep on a questionnaire. You can read or help your child with this questionnaire.
4. Your child showing me their completed workbooks at school. I will ask the child's permission at that time to take photos of some of their work.

More information about this study and a consent form are attached.

Please email, call, or text me (details above) if you have questions and I will telephone you in the evening. Or you can telephone or text my senior supervisor, Kathleen Liberty, on 027 349 0645.

If you are interested in participating, you can also read over the attached information and post back the consent form to me.

Thank you for your time,

Chao Gu

Chao Gu
School of Health Sciences, College of Education
Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Information Sheet for Parent/Caregiver

My name is Chao Gu and I am completing a Master thesis in Child and Family Psychology. The aim of my thesis is conduct a small study to see if the Sleep Education programme has any effects on children's sleep and memory. This is because some studies say that improved sleep brings about improved memory.

I would like to invite you and your child to participate in my study. Participation involves the following activities at 3 time-points: about a week before the teaching programme begins, a week after the teaching programme, and a week next term (3 weeks in total).

1. Helping your child complete a brief report on their sleep for 7 nights (8 mornings). This will take less than a total of 5 minutes per day. If your child takes the tests at home, I can pick them up then, or, if they take the test at school, they can bring them to me.
2. Your child completing two short tests of memory on an iPad. At most this will take 15 minutes. These tests can be taken at home, if you prefer, or at school.
3. Your child answering 26 questions about their sleep on a questionnaire (Sleep Self Report). Either the researcher Chao Gu or you can assist your child with this questionnaire, or it can be completed at school.
4. Your child showing me their completed workbooks at school. I will ask the child's permission at that time to take photos of some of their work.

Please note on the form if you wish to have the tests and questionnaire at home, and the researcher, Chao Gu, will phone or email you a time to come to your home. You can sit with your child while the researcher goes through the forms and shows the child the tests. Your child and you have the right to refuse to complete these at the time, and the researcher will thank you and leave if that is your choice.

If you and your child are interested in being involved in this study, please discuss the contents of the attached information sheet and consent form with your child. Ten children from your child's school, who have a sleep problem and were living in Christchurch during the earthquakes will be able to participate. Participating in the research study or not will not affect your child's learning about sleep at school.

Please note that participation in this study is voluntary and the right to withdraw at any stage without penalty is maintained. If this occurs, all related information will be erased. Your child will be asked for their individual assent to participate in the tests at each time point, and for the researcher to see and photograph their sleep work books. If at any point your child expresses that he or she does not want to participate, then the researcher (me, Chao Gu) will thank them and leave.

I will take particular care to ensure the confidentiality of all data gathered for this study. I will also take care to ensure anonymity in publications of the findings. Coded data will only be accessible by me and by my supervisors prior to submission. All the data will be securely stored in password protected facilities and locked storage at the University of Canterbury and will be destroyed after five years following the study. You will receive a summary of this study. Data from this study will be published in a thesis and may be published in an academic journal or presented at a conference.

If you require further information, please contact the researcher, Chao Gu (details above) or her supervisor, Kathleen Liberty, on 027 349 0645 or kathleen.liberty@canterbury.ac.nz.

This project has received ethical approval from the University of Canterbury Educational Research Human Ethics Committee. Participants should address any complaints about the study to the Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz).

Thank you for your time, Chao

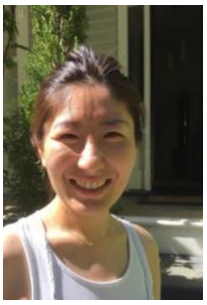
Chao Gu
School of Health Sciences, College of Education
University of Canterbury
Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Information Sheet for Child

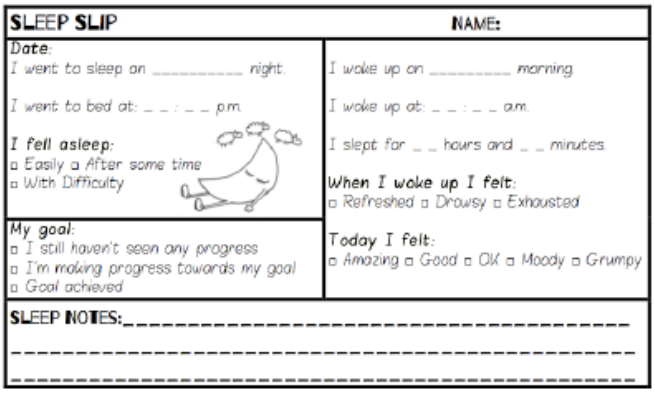
My name is Chao Gu and I am doing a study at the university. Here is a photo of me!



I am asking you to help me understand more about children's sleep and their memory. Your teacher and school will be helping you learn more about sleep this term. My study is happening around this teaching.

There are three activities. Each activity will occur at 3 time points.
1. Before the teaching starts. This is called a 'baseline' and it shows where you are now.
2. After you finish the sleep programme. This will show what, if anything, the programme did.
3. The start of next term. This will show if there are any effects on sleep and memory later on.

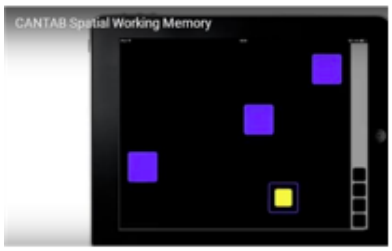
These are the activities that you would do as part of the study.
1. Fill out a sleep slip for a week. The sleep slip will look like this (only a bit bigger). You can ask your parent to help you with this if you want. Or you can fill it out by yourself.



Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Information Sheet for Child, page 2

2. After you have completed the sleep diary for seven day, or on a day that you and your parent or caregiver agree, you will be asked to take two memory tests on an iPad. These tests will involve looking for a hidden shape in some boxes, and remembering a photograph of a person's face and how they looked. These tests will take about 15 minutes in total. You can take the tests at home or at school. You can change your mind if you don't want to do the tests.



3. After that, we will go through some questions in detail about your sleep. It is called "Sleep Self Report". There are 26 questions, but this should only take about 10 minutes. Your parents and caregivers or I can help you with this if you want.

4. After you have finished the sleep programme, I would like to look at your work on this programme with you. I will also ask you if I can take a photo with my phone of some of your work. You don't have to show this to me if you don't want to.

I will write up the study. This is so the results can be shared with other scientists.

You will be given a code name in the write-up of my study so that no one will know your name, the name of the person who looks after you, or your teacher's name or your school.

Also, you will be able to receive a summary of the study, and your own results. You may also like to choose a colouring book or a sticker book as a koha from me.

If you have any questions, you can talk to your parents and caregivers, teacher or to me. If you change your mind about being in this study, that is fine too. All you have to do is tell your parents or caregivers or me.

Thank you for thinking about helping me with my study,

Chao Gu

SLEEP SELF REPORT
(Child's Form)

_____
Coding

R = REVERSE SCORING
HIGHER SCORE INDICATES MORE PROBLEMATIC SLEEP

These questions are about <u>your</u> sleep. The researcher Chao Gu or your parent or caregiver will explain the form and read you the questions. Please mark your answer to each question in the box. There are no right or wrong answers. Please ask if you do not understand a question. Thank you!

1. Who in your family sets the rules about when you go to bed?
   ☐ Mom ☐ Dad ☐ You ☐ Caregiver(s) ☐ Other: _____
2. Do you think you have trouble sleeping? ☐ Yes ☐ No
3. Do you like to go to sleep? ☐ Yes ☐ No

BEDTIME	**(3) Usually (5-7)/ week**	**(2) Sometimes (2-4)/ week**	**(1) Rarely (0-1)/ week or never**
4. Do you go to bed at the same time every night on school nights? **(R)**	☐	☐	☐
5. Do you fall asleep in the same bed every night? **(R)**	☐	☐	☐
6. Do you fall asleep alone? **(R)**	☐	☐	☐
7. Do you fall asleep in parents', brothers', or sisters' bed?	☐	☐	☐
8. Do you fall asleep in about 20 minutes? **(R)**	☐	☐	☐
9. Do you fight with your parents about going to bed?	☐	☐	☐
10. Is it hard for you to go to bed?	☐	☐	☐
11. Are you ready for bed at your usual bedtime? **(R)**	☐	☐	☐
12. Do you have a special thing (doll, blanket, etc.) you bring to bed?	☐	☐	☐
13. Are you afraid of the dark?	☐	☐	☐
14. Are you afraid of sleeping alone?	☐	☐	☐
15. Do you stay up late when your parents think you are asleep?	☐	☐	☐
SLEEP BEHAVIOR			
16. Do you think you sleep too little?	☐	☐	☐
17. Do you think you sleep too much?	☐	☐	☐
18. Do you wake up at night when your parents think you're asleep?	☐	☐	☐
19. Do you have trouble falling back to sleep if you wake up during the night?	☐	☐	☐
20. Do you have nightmares?	☐	☐	☐
21. Does pain wake you up at night? Where is that pain?	☐	☐	☐
22. Do you sometimes go to someone's bed during the night? If yes,	☐	☐	☐

who? _____

	(3) Usually (5-7)/ week	(2) Sometimes (2-4)/ week	(1) Rarely (0-1)/ week or never
DAYTIME SLEEPINESS			
23. Do you have trouble waking up in the morning?	☐	☐	☐
24. Do you feel sleepy during the day?	☐	☐	☐
25. Do you take naps during the day?	☐	☐	☐
26. Do you feel rested after a night's sleep? **(R)**	☐	☐	☐

Appendix G: Parent/Caregiver Consent Form

Chao Gu
School of Health Sciences, College of Education
Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Consent Form for Parent/Caregiver

I have been given a full explanation of this study and have been given an opportunity to ask questions. I understand what will be required of myself and of my child if we agree to take part in this study.

I understand that my participation and that of my child is voluntary and that we may withdraw at any stage without penalty. It is also understood that if this occurs, all information regarding my child and myself will be removed from the study and destroyed.

I understand that data from this study will be published in a thesis and could be published in an academic journal or presented at a conference. I understand that any information I, or my child, provide will be kept confidential to the researcher, Chao Gu, and will not identify us.

I understand that all data collected for this study will be kept in locked and secure storage facilities at the University of Canterbury and will be destroyed after five years.

I understand that I am able to request a report on the findings of this study.

I understand that if I require further information I can contact the researcher, Chao Gu, or her supervisor, Kathleen Liberty. If I have any complaints I can contact the Chair of the University of Canterbury Educational Research Human Ethics Committee.

By signing below, I am declaring that I have read and understood the statements above and agree to fulfil my role to allow the completion of this study. I have also read the information sheet to my child and I give my consent for him/her to participate in this study. My child has also signed a separate form.

Your Name (please print): _____

Your child's name (please print): _____

Your child's current sleep:

Parent to Answer	
Does your child have any problems at bedtime?	
Does your child have any one of these (please tick}? - difficulty waking in the morning, □ - seem sleepy during the day or □ - take naps? □	

Please Turn Over

Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Consent Form for Parent/Caregiver, page 2

Parent to Answer	
Does your child seem to wake up a lot at night?	
Any sleepwalking or nightmares?	
What time does your child go to bed and get up on **school days?**	Bedtime: Get up time:
What time does your child go to bed and get up on **weekends?**	Bedtime: Get up time:
Do you think he/she is getting enough sleep?	
Does your child have loud or nightly snoring or any breathing difficulties at night?	
Did your child live in Christchurch for most of the time during the earthquakes (September 2010 to December 2013)?	

Your signature: _____ Date: _____

Your Phone Number _____

Your Email address: _____

Please circle:
1. Preferred contact is (a) email , (b) telephone call (c) text message (d) other.
2. Preferred location for child to complete the questionnaire and memory tests: (a) School (b) Home (Chao will contact you to set up a day, date and time)

Please post this form in the enclosed envelope to the researcher, Chao Gu if you consent. If you do not consent, do not sign the form. Do not return the form to school.

Appendix H: Child Consent Form

Chao Gu
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University of Canterbury
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Email: chao.gu@pg.canterbury.ac.nz

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Consent Form for Child

My parent has told me about your study.

I am happy to help you with your study about my sleep and my memory.

I know that any information collected about me will not be told to anyone else and will be stored away in a locked cabinet. Chao will not use my name or my parents and caregivers'/teacher's/school's names in the study. All information will be destroyed after the study has been written up. My parents and caregivers and I will receive a short report of the study.

I understand that I can change my mind about being in this study and no one will mind.

I know that if I have any questions I can ask my parents and caregivers, my teacher, or Chao.

This is what I think about my sleep right now.

Child to Answer	
How old are you?	
Do you have any problems going to bed?	
Do you feel tired a lot?	
Do you wake up a lot at night?	
Do you have trouble getting back to sleep if you wake up in the middle of the night?	
Do you have bad dreams?	

Your name (please print): _____ _____ Date: _____

Your signature _____ _____

Give this form to your mum or dad or caregiver only if you want to be in the study.

Appendix I: Sleep Diary

SLEEP SLIP **NAME:**

Date:

I went to sleep on _____ night

I went to bed at: _ _ : _ _ p.m.

I fell asleep:

- *Easily*
- *After some time*
- *With Difficulty*

I woke up on _____ morning

I woke up at: _ _ : _ _ a.m.

I slept for _ _ hours and _ _ minutes

When I woke up I felt:

- *Refreshed*
- *Drowsy*
- *Exhausted*

My goal:

- *I still haven't seen any progress*
- *I'm making progress towards my goal*
- *Goal achieved*

Today I felt:

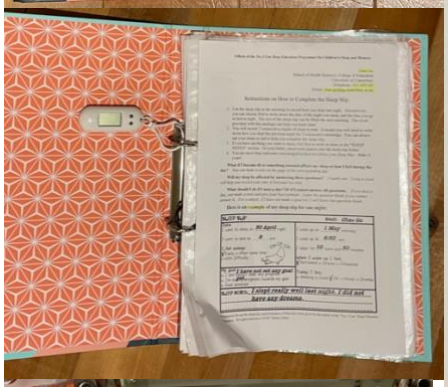
- *Amazing*
- *Good*
- *OK*
- *Moody*
- *Grumpy*

SLEEP NOTES:_____

_____

_____

Appendix J: Sleep Folder



Effects of the *Yes I Can Sleep Education Programme* On Children's Sleep and Memory

Chao Gu
School of Health Sciences, College of Education
University of Canterbury
Telephone: 021 459 102
Email: chao.gu@pg.canterbury.ac.nz

Instructions on How to Complete the Sleep Slip

1. Use the sleep slip in the morning to record how you slept last night. Alternatively, you can choose first to write down the date of the night you sleep, and the time you go to bed at night. The rest of the sleep slip can be filled the next morning. The clock provided with this package can help you track time!
2. You will record 7 consecutive nights of sleep in total. It means you will need to write down how you slept the previous night for 7 consecutive mornings. You can always ask your mum or dad to help you complete the sleep slip.
3. If you have anything you want to share, feel free to write or draw in the "SLEEP NOTES" section. Or even better, insert extra papers into the sleep slip folder.
4. You are more than welcome (encouraged in fact) to colour your sleep slips. Make it yours!

What if I become ill or something unusual affects my sleep or how I feel during the day? *You can make a note on the page of the corresponding day.*

Will my sleep be affected by answering these questions? *Usually not. Using a clock will help you record your time of bed and rise time.*

What should I do if I miss a day? *Or* if I cannot answer all questions, *If you miss a day, just make a note and give your best estimate. Leave the question blank if you cannot answer it.. For example, if I have not made a goal yet, I will leave that question blank.*

Here is an example of my sleep slip for one night:

SLEEP SLIP NAME: *Chao Gu*

Date:
I went to sleep on *30 April* night.
I went to bed at: *8* p.m.
I fell asleep:
√ Easily ◻ After some time
◻ With Difficulty

I woke up on *1 May* morning
I woke up at: *6:30* a.m.
I slept for *10* hours and *30* minutes
When I woke up I felt:
√ Refreshed ◻ Drowsy ◻ Exhausted

My goal: *I have not set any goal yet.*
◻ I still haven't seen any progress
◻ I'm making progress towards my goal
◻ Goal achieved

Today I felt:
◻ Amazing ◻ Good √ OK ◻ Moody ◻ Grumpy

SLEEP NOTES: *I slept really well last night. I did not have any dreams.*

Appendix K: Sleep Self-Report (SSR)

SLEEP SELF REPORT
(Child's Form)

Coding

R = REVERSE SCORING
HIGHER SCORE INDICATES MORE PROBLEMATIC SLEEP

These questions are about your sleep. The researcher Chao Gu or your parent or caregiver will explain the form and read you the questions. Please mark your answer to each question in the box. There are no right or wrong answers. Please ask if you do not understand a question. Thank you!

1. Who in your family sets the rules about when you go to bed?
   ☐ Mom ☐ Dad ☐ You ☐ Caregiver(s) ☐ Other: _____
2. Do you think you have trouble sleeping? ☐ Yes ☐ No
3. Do you like to go to sleep? ☐ Yes ☐ No

BEDTIME	**(3) Usually (5-7)/ week**	**(2) Sometimes (2-4)/ week**	**(1) Rarely (0-1)/ week or never**
4. Do you go to bed at the same time every night on school nights? **(R)**	☐	☐	☐
5. Do you fall asleep in the same bed every night? **(R)**	☐	☐	☐
6. Do you fall asleep alone? **(R)**	☐	☐	☐
7. Do you fall asleep in parents', brothers', or sisters' bed?	☐	☐	☐
8. Do you fall asleep in about 20 minutes? **(R)**	☐	☐	☐
9. Do you fight with your parents about going to bed?	☐	☐	☐
10. Is it hard for you to go to bed?	☐	☐	☐
11. Are you ready for bed at your usual bedtime? **(R)**	☐	☐	☐
12. Do you have a special thing (doll, blanket, etc.) you bring to bed?	☐	☐	☐
13. Are you afraid of the dark?	☐	☐	☐
14. Are you afraid of sleeping alone?	☐	☐	☐
15. Do you stay up late when your parents think you are asleep?	☐	☐	☐
SLEEP BEHAVIOR			
16. Do you think you sleep too little?	☐	☐	☐
17. Do you think you sleep too much?	☐	☐	☐
18. Do you wake up at night when your parents think you're asleep?	☐	☐	☐
19. Do you have trouble falling back to sleep if you wake up during the night?	☐	☐	☐
20. Do you have nightmares?	☐	☐	☐
21. Does pain wake you up at night? Where is that pain?	☐	☐	☐
22. Do you sometimes go to someone's bed during the night? If yes,	☐	☐	☐

who? _____

	(3) Usually (5-7)/ week	(2) Sometimes (2-4)/ week	(1) Rarely (0-1)/ week or never
DAYTIME SLEEPINESS			
23. Do you have trouble waking up in the morning?	☐	☐	☐
24. Do you feel sleepy during the day?	☐	☐	☐
25. Do you take naps during the day?	☐	☐	☐
26. Do you feel rested after a night's sleep? **(R)**	☐	☐	☐

Appendix L: Teacher's Feedback Form

Implementation of The *Yes I Can Sleep Education Programme* (Liberty, 2017)

<table>
<tr><td colspan="2">Room:
Teacher's Name:</td><td>Any feedback you have received from the students:
Any comments / suggestions you would like to make on the Yes I Can Sleep Education Programme:</td></tr>
<tr><td>Term and week Started the Yes I Can Sleep Education Programme</td><td></td><td rowspan="6"></td></tr>
<tr><td>Term and week Completed the Yes I Can Sleep Education Programme</td><td></td></tr>
<tr><td>How many sessions per week? (For example, the once a week)</td><td></td></tr>
<tr><td>How long did each session last approximately? (For example, 45-60 minutes)</td><td></td></tr>
<tr><td>How many weeks were the programme taught for? (For example, 10 weeks in total)</td><td></td></tr>
<tr><td colspan="2">Would you like to share pictures of the sleep booklets from children in your class? (If Yes, please kindly attach them to the email)</td></tr>
</table>

* The Information you are about to provide will only be used to help Chao Gu to describe the delivery of the Yes I Can Sleep Education Programme when she writes up her thesis.